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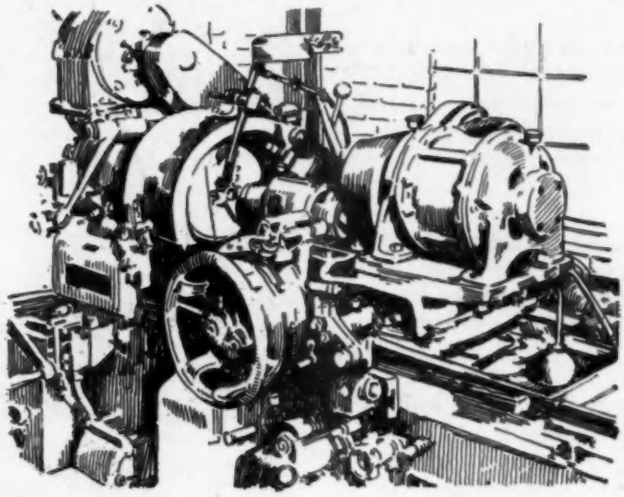


WHAT OBSOLETE EQUIPMENT COSTS

A machine tool plant sacrifices $20,000 a year to the Great God Tradition

IN THE first article in this series, published in Vol. 70, No. 20, we calculated how much it cost a railroad management not to replace certain equipment that richly deserved such a fate. The point was also made that the railroad repair shops were generally suffering from the same handicap of obsolete equipment partly by reason of the inadequate returns allowed the railroads by government control, and partly because of the belief on the part of conservative railroad officials that their repair shops should be classified as necessary evils, and treated accordingly.

Not so many years ago it would have been fair to make the same statement about the majority of the shops in which machine tools are built. Within the last few years, however, most of the machine tool builders have been making some money, and many of them have promptly instituted equipment replacement campaigns in their own shops, with results that have been gratifying.

The shop to be considered this time should be looked upon, therefore, as an exception to the general rule but at the same time a horrible example of what it costs to "keep the old machines going for just one more year." To get at the actual cost of this policy the same three formulas used in the original article will be applied to three specific jobs, so that the reader may take his choice of the methods, or modify any one of them to suit his own ideas.

Although there were many pieces of equipment in this shop that could have been replaced to advantage, the superintendent knew the attitude of his superiors in office and finally selected the worst three cases for his effort. He had his current production figures, of course, and to compare with them he had the production estimates of the builders of the machines he hoped to get. Let's see what they looked like.

The first job was the grinding of the taper hole in a lockbolt bushing. With the old grinder the set-up time was 45 min. and the grinding time per piece was 6 min. As the bushings were put through in lots of 300 the total time per piece was 6.15 min. On a modern internal grinder with automatic features the estimated set-up time was 60 min., and grinding time per piece, 1.6 min., or a total time per piece of 1.8 minutes.

Now, according to the Warner & Swasey method of calculating savings, labor is assumed to cost 60 cents per hour and overhead 90 cents, a total of $1.50 per hour, or 2½ cents per minute. On this basis

Present cost per piece = 6.15 min. × 2½ cents per min. = $0.1537

Estimated cost per piece = 1.8 min. × 2½ cents per min. = $0.045

Gross savings per piece = $0.1087

Based on an 8-hr. working day and 280 working days per year, the gross savings per year would be 266.7

(pieces per day) × 280 days × $0.1087 cents per piece = $8,117.

From this sum must be deducted the interest on the investment and the depreciation, which can be conservatively figured at 20 per cent.

Cost of new grinder	= $6,315
Depreciation at 20 per cent	= $1,263
Net saving = $8,117 — $1,263	= $6,854

According to this method of calculation the company would save $6,854 the first year through installing the new grinder.

But what would the estimated saving be according to the formula of the SKF companies? The formula is this:

$$M = \frac{C_E + C_T + C_{IX} + C_{DX} + V_B}{(R_P - R_E)N_D D_M + S_{OHM}}$$

In which

- M = the number of months in which the equipment will pay for itself
- C_E = the cost of the new equipment to be installed
- C_T = the cost of tooling the new equipment
- C_{IX} = the cost of interest for X years at 6 per cent, X equaling the number of years determined upon as the maximum time during which the equipment must pay for itself
- C_{DX} = the cost of depreciation for X years at 10 per cent, X having the same value as above
- V_B = the book value of the displaced equipment
- R_P = the present rate (cost) per piece
- R_E = the estimated rate (cost) on the new equipment
- N_D = the number of pieces to be produced per day on the proposed equipment
- D_M = the number of working days per month
- S_{OHM} = the savings in overhead per month

In the case under consideration the old equipment had been written off the books and it had no scrap value. Then

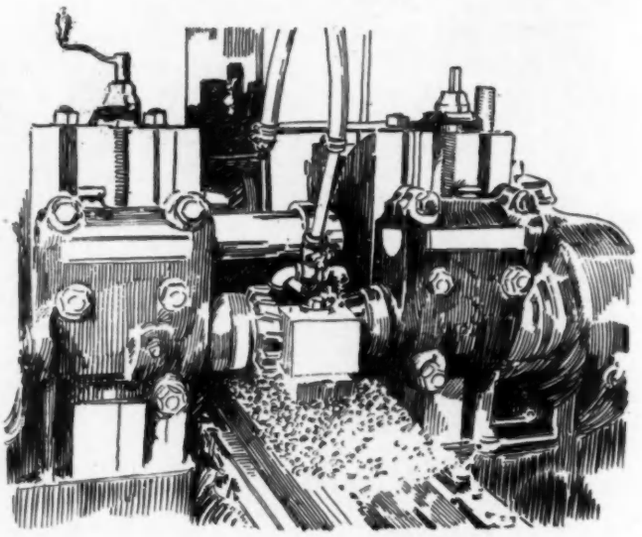
C_E = $6,315
C_T = 0
C_{IX} = $1,894.50
C_{DX} = $3,157.50
V_B = 0
R_P = $0.1537
R_E = $0.045
N_D = 266.7
D_M = 24
S_{OHM} = 0 (included in calculation of rate per piece)

$$\text{Then, } M = \frac{\$6{,}315 + 0 + \$1{,}894 + \$3{,}157.50 + 0}{(\$0.1537 - \$0.045)266.7 \times 24 + 0}$$
$$= 17 \text{ months}$$

If the new grinder paid for itself in 17 months it must have accomplished savings equal to its original cost, or $6,315. In 12 months, therefore, it would save 12/17 of $6,315, or $4,460.

To round out the picture we should apply the longer formula of the A.S.M.E. The definitions of the various terms used in the formula are as follows:

- A = interest rate, or yearly allowance on investment
- B = yearly percentage allowance for insurance, taxes, etc.
- C = yearly percentage allowance for upkeep
- E = yearly cost of power, supplies, etc., in dollars
- h = expected number of years of life of equipment
- I = initial cost of new equipment, in dollars
- K = unamortized value of equipment displaced, less its scrap value, in dollars
- X = percentage of year during which equipment will be in use
- S = yearly saving in direct labor cost, in dollars
- T_a = yearly saving in labor burden, in dollars
- T_b = yearly fixed charges on old equipment, in dollars
- U = yearly saving or earning through increased production, in dollars
- Y = yearly cost to maintain new equipment ready for operation, in dollars (fixed charges)
- V = yearly net operating profit from new equipment, in excess of fixed charges, in dollars



According to the information on the job under discussion the values of the factors are:

$A = 0.06$ $B = 0.01$ $C = 0.05$
$E = 0$ (included in C) $h = 5$
$I = \$6{,}315$ $K = 0$
$X = 0.93$ $(280 \div 300)$
$S + T = \$8{,}117.00$
$T_b = \$100$ (an arbitrary assumption) $U = 0$

The formula for

$$Y = I\left(A + B + C + \frac{1}{h}\right)$$
$$= \$6{,}315(0.06 + 0.05 + 0.001 + 0.20)$$
$$= \$2{,}025$$

$$V = [(S + T_a + U - E)X + T_b] - \left[Y + K\left(A + \frac{1}{h}\right)\right]$$
$$= (\$8{,}117 + 0 - 0)0.93 + \$100 - \$2{,}025 - 0$$
$$= \$7{,}650 - \$2{,}025$$
$$= \$5{,}625$$

This sum represents the savings attributable to the new grinder according to the third way of looking at it.

But what about the other two replacements?

The second one had to do with a milling job. The job was the machining of a steel forging for a turret.

Existing equipment was a standard knee-type milling machine and the superintendent hoped to replace it with a duplex miller. The situation was much the same as that of the locomotive crosshead in the previous article, and the indicated savings of the same order of magnitude.

The existing production time per piece was 32.64 min.; the estimated time, 12 min. Set-up times were respectively 60 min. and 90 min., and there were 25 pieces in a lot. The total times, therefore, were 35.04 min. and and 15.6 min., respectively.

The cost of the new machine was $4,560, and of the necessary fixture, $60. The book value of the old machine was $165 and its resale value $400. Applying these amounts in our three formulas we get, for the Warner & Swasey method,

Present cost per piece—35 × 2½ cents	=	$0.875
Estimated cost per piece—15.6 × 2½ cents	=	0.39
Gross savings per piece	=	$0.485
Gross savings per year 30.7 × 280 × $0.485	=	$4,169
Cost of new milling machine	=	$4,560
Cost of fixture	=	60
Total Cost	=	$4,620
Depreciation on investment:		
20 per cent on machine	=	$912
100 per cent on fixture	=	60
Total Depreciation	=	$972
Net saving	= $4,169 — $972 =	$3,197

According to the SKF formula, where

$C_E = \$4{,}560$
$C_T = \$60$
$C_{IX} = \$1{,}386$
$C_{DX} = \$2{,}310$
$V_B = \$235\ (\$400 - \$165)$
$R_P = \$0.875$
$R_E = \$0.39$
$N_D = 30.7$
$D_M = 24$
$S_{OHM} = 0$

$$M = \frac{\$4{,}560 + \$60 + \$1{,}386 + \$2{,}310 - \$235}{(\$0.875 - \$0.39)30.7 \times 24 + 0}$$

$= 23$ months.

The annual saving, therefore, would be $\frac{12}{23}$ of $4,620, or $2,410.

According to the A.S.M.E. formula, where

$A = 0.06 \qquad B = 0.01 \qquad C = 0.05$
$E = 0$ (Included in C) $\qquad h = 5$
$I = \$4{,}620$
$K = \$235\ (\$400 - \$165)$
$X = 0.93$
$S + T_a = \$4{,}169 \qquad T_b = \$50$
$U = 0$
$Y = \$4{,}620\ (0.06 + 0.01 + 0.05 + 0.20)$
$= \$1{,}480$
$V = (\$4{,}169 + 0 - 0)0.93 + \$50 - \$1{,}480 + (-\$235 \times 0.26)$
$= \$3{,}880 + \$50 - \$1{,}480 - \$61$
$= \$2{,}389.$

The agreement between the results obtained by the last two formulas is surprisingly close.

The third job chosen for replacement of equipment was a layout for machining collets. Here the superintendent took his courage in both hands and estimated on using a station-type, vertical, automatic chucking machine the cost of which was $25,090. The tooling cost in addition was $8,503 and the book value of the old equipment was $3,000. The old production time was 139 min. per piece, and the estimated time 15.5 min. per piece.

According to the first formula:

Present cost per piece = 139 × 2.5 cents	=	$3.475
Estimated cost per piece = 15.5 × 2.5 cents	=	$0.3875
Gross saving per piece	=	$3.0875
Gross saving per year = 31 × 280 × $3.0875	=	$26,800
Cost of machine	=	$25,090
Cost of tooling	=	$8,503
Total cost of new equipment	=	$33,593
Depreciation on investment		
20 per cent on machine	=	$5,018
100 per cent on tooling	=	$8,503
Total depreciation	=	$13,521
Net saving = $26,800 — $13,521	=	$13,279

In this case the result is unfair to the machine because

it is highly improbable that the expensive tooling would be useless after the end of the first year.

According to the SKF formula, where

$C_E = \$25{,}090$
$C_T = \$8{,}503$
$C_{IX} = \$10{,}090$
$C_{DX} = \$16{,}800$
$V_B = \$3{,}000$
$R_P = \$3.475$
$R_E = \$0.3875$
$N_D = 31$
$D_M = 24$
$S_{OHM} = 0$

$$M = \frac{\$25{,}090 + \$8{,}503 + \$10{,}090 + \$16{,}800 + \$3{,}000}{(\$3.475 - \$0.3875)31 \times 24 + 0}$$

$= 27$ months.

The annual saving would be $\frac{12}{27}$ of the original cost \$33,593, or \$14,950, rather more than by the preceding method.

For the A.S.M.E. formula we have these values:

$A = 0.06 \quad B = 0.01 \quad C = 0.05$
$E = 0$ (Included in C) $\quad h = 5$
$I = \$33{,}593$
$K = \$3{,}000$
$X = 0.93$
$S + T_a = \$26{,}800$
$T_b = \$500 \quad U = 0$

Then, $Y = \$33{,}593(0.06' + 0.01 + 0.05 + 0.20)$
$= \$8{,}575$

$V = (\$26{,}800 + 0 - 0)\ 0.93 + \$500 - [\$8{,}575 + \$3{,}000\ (0.06 + 0.20)]$
$= \$16{,}095.$

In this instance the A.S.M.E. formula shows the greatest saving of the three. The saving estimated is appreciable in each case but it would be considerably greater if assumptions not quite so conservative had been made. For instance, five years is an extremely short life for any piece of equipment costing over \$30,000. If you disagree with the assumptions, substitute in the formulas the values that seem right to you and arrive at your own estimate of the savings to be made—or the loss to be suffered if the equipment is not purchased.

The sad part of this story is that the superintendent of this machine tool plant was unsuccessful in getting approval of his request for the three machines. The annual loss to the company was, therefore:

According to the Warner & Swasey formula	—\$23,330
According to the SKF formula	—\$21,820
According to the A.S.M.E. formula	—\$24,009

And please remember that these three machines were only the most urgent replacement cases. There were plenty of others of others that might have been replaced to advantage.

THE foregoing article is the second in the series "What Obsolete Equipment Costs." The first was published in Vol. 70, No. 20, p. 764, and dealt with the loss suffered in a railroad repair shop through failure to replace the obsolete equipment used on three different jobs. The next article will appear in an early issue.

SEEN · AND · HEARD

BY JOHN R. GODFREY

Hardening With Nitrogen Trimming Hardened Dies The Chemist in the Shop

THE shop man who wants to know what it's all about has to keep busy these days, especially in the matter of new materials and the way in which they are used. Casehardening is as old as the hills to most of us, meaning the use of cyanide, or charred bone or leather to work a little carbon into the surface of low-carbon steel so that it will harden. Then the chemist came along and showed us how to harden with ammonia gas. Tried out in automobile and airplane engine cylinders, this nitrided surface seems to have a remarkably long life. Here is one more thing on which shop men must get posted.

* * * *

ONE of the first questions regarding any new cutting tool is "how fast will it cut?" But there are other things of equal importance in some lines of work. As an example I ran across a case where the useful life of upsetting dies was greatly prolonged because they found that a tool made of the new tungsten-carbide alloys would trim up the hardened die after it began to wear, and make it as good as new.

Before the new tools appeared the die had to be annealed and refaced. There was also danger of cracking, and it became a question as to whether it was cheaper to rework it or discard it for a new one. With the new tools, it is only necessary to take the hardened die to the machine shop where a formed tool of the new alloy cuts out the worn surfaces and leaves the die as good as new in a few minutes, with no reheating or its attendant bother. Speed isn't the only thing that counts.

* * * *

I HAVE felt for a long time that the chemist and the metallurgist were among the most important people in industry. And this is beginning to be recognized if we can judge by the increase in the number of both that we find in industry today, even in comparatively small shops.

Just as an example of how they fit into shop work, take the case of pickling steel forgings in sulphuric or nitric acid to remove the scale. It does a good job, but it also seems to make the steel a bit brittle. The chemist finds out "why" and tells us to boil the pickled forgings in water for a half hour, and the brittleness practically disappears. He also shows that pickling in an electric bath in neutral or alkaline solutions does not make the steel brittle, and so avoids the necessity for boiling. He is telling us a lot of other things too, that all help industry in one way or another.

Semi-Annual Review Number—July 18

Machining a Forged Flywheel

Photographs by courtesy of the Stutz Motor Car Company.

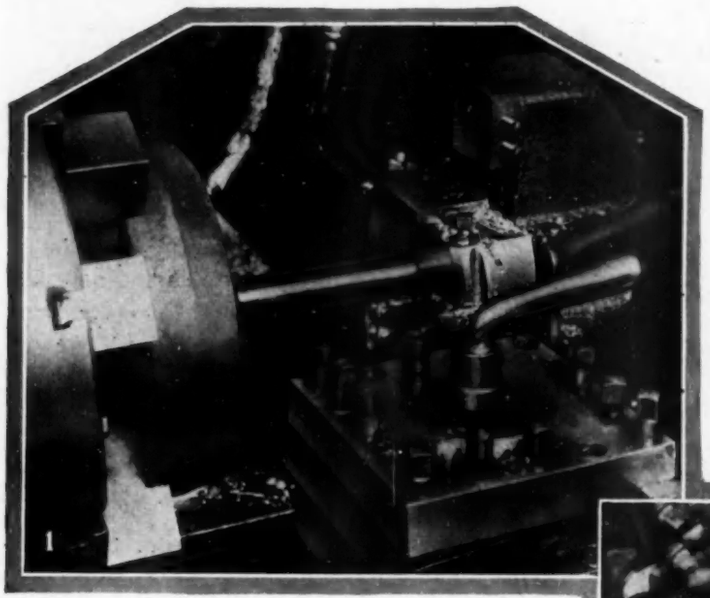


Fig. 1—Rough boring and facing a forged flywheel in a Libby turret lathe. This operation rough bores the hole, counterbores the face of the wheel with the piloted tool shown, and rough turns the outside as far as the chuck jaws

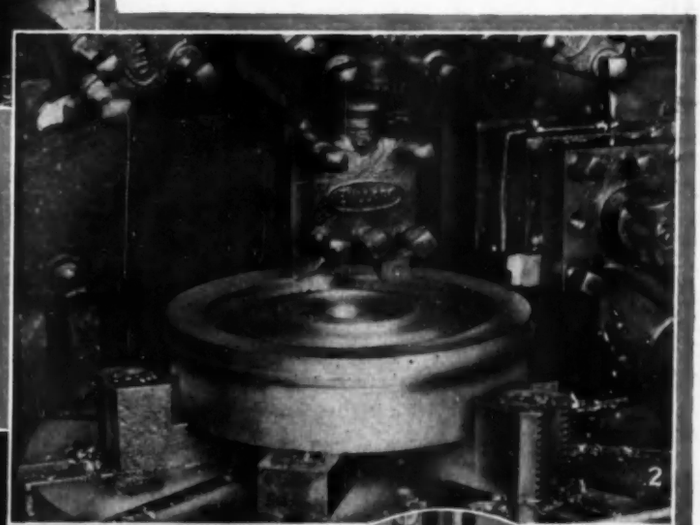


Fig. 2—Machining the other side of the flywheel on a Bullard vertical turret lathe. This view indicates the way in which the various tools are arranged for performing the different operations. The shoulder is used for locating the starting ring-gear and is finished by the tool shown in the side head

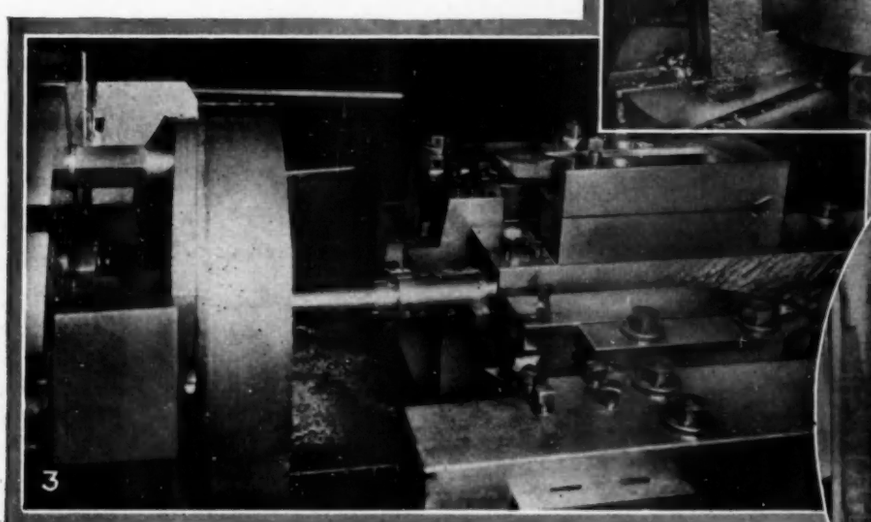
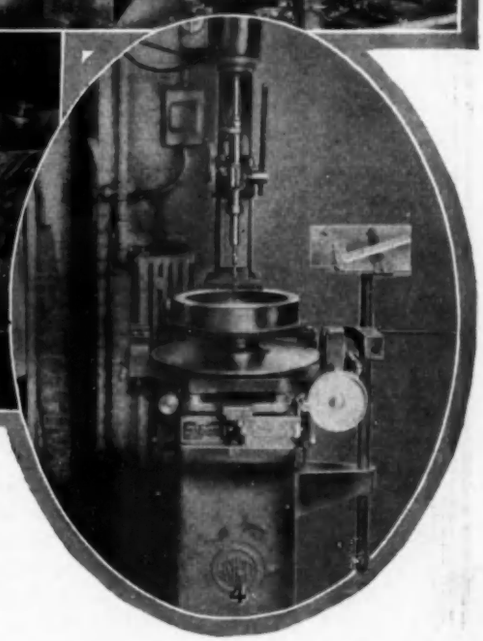


Fig. 3—The third operation is done on a Simplimatic. This shows the type of chuck jaw and the supports between the jaws used in holding the flywheel. The tool set-ups, both in the boring bar and in the tool head, are clearly shown. Fig. 4—Balancing the finished flywheel on a Gisholt static balancer that contains a drilling head, so that metal can be removed from any point. The amount of metal to be removed is given on the chart at the right-hand side of the machine



EXECUTIVE · FORUM

Hiring Back Old Men First

"SIT in with us, Holland," said Ed Hinkle to our free-lance consultant at the club one noon. "We're trying to settle this business of personnel or employment departments, and you ought to be able to help a bit."

"You've picked out some job for one lunch hour, Ed," laughed Bill Holland. "Many concerns have spent thousands of dollars and don't know it all yet."

"Oh, we don't mean any of this coddling or welfare business, Bill. That's gone up the flue long ago. Hiring and firing is just a plain business proposition. If you need men you hire the best you can pick out of those who come along. If you don't you let them go until business picks up," said Hinkle.

"Sort of hard-boiled today, aren't you, Ed," said Henry Brown, manager of one of the best plants in town. "We don't work it just that way. We try to keep good men with us as long as we can. If we have to lay them off, we try mighty hard to get them back when business picks up again."

"That's a good theory," chimed in Charlie Buckner, "but it means a lot of office work keeping records, and I wonder if it's worth while. If there were a shortage of men it might be necessary, but we find the men we hire average about the same."

"You're wrong there, Charlie," said Brown. "Men who know your work and your machines just can't help being better than men who don't, assuming they are all average men. It is supposed to cost from fifty to two hundred dollars to break in a new man in the average shop, and it's a lot more in some cases. We find that when we have men who have been with us for a long time we get out more work and have less trouble than after we've had to hire in a bunch of new men. What has been your experience, Bill?" said he, turning to Holland.

"I've been watching the employment game pretty closely for a long time, Henry, and I'd say you were right, other things being equal. Can't just see how it could very well be otherwise if there's a good feeling between the men and the management. If there isn't, almost anything can happen, and one foreman hasn't much chance against from ten to fifty men with a grouch."

"But you can't coddle the men, Holland," said Hinkle. "You'll spoil 'em sure."

"If the boss is a square shooter, Ed, they don't mind knowing that he is boss. But many concerns are finding out that it pays to be as human as possible. Pays in dollars and cents too, Ed, not just in satisfaction.

"I know one shop that makes a point of hiring back every man who was laid off before taking on any new ones, unless the man has got a job elsewhere. And it isn't just because they want to be nice, either.

"They found cases where when a new man was taken on instead of an old man the old man's wife and family came to the conclusion that Dad wasn't so good as they thought he was. And when a man's stock begins to drop in his own family he's on the down path. No matter how ordinary he may be, as long as the family thinks he's O.K., there's some fun in living. But when Ma and the kids begin to look down on him, he isn't much use to himself or to anyone else."

"But we can't consider the family side of the case, Holland. We've got to think of the shop."

"Of course, Ed. And it's just because these family affairs do affect production that I mention them. You may think that you have nothing to do with things outside the shop. But if flower beds, gymnasiums, or a man's status at home affect production, then it's something to think about. Some of the most successful shops find that good-will frequently means real money in actual production, and that keeping men who know the work pays real dividends."

Executives are invited to discuss the problem involved in the foregoing case. They are also urged to use this department to air their own problems. A letter to the Executive Forum Editor is all that is needed.

Discussion

Can Shop Losses Be Charged to Sales?

The question as to whether the head of the company was right by letting special small lines enter and upset the production of the machine shop, is another matter. The complaint of the superintendent was quite in order, as he is the man who would be first to blame if production fell off. There is no surer way of stopping production than setting up machines for small lots, and the superintendent was naturally anxious to keep such work out of his department.

The sales manager considered it good business to keep special lines in stock in order to attract new business. But he should at least know the cost of doing so, to see if the practice is worth while in each case. If he is unable to measure the cost of manufacturing the special items in his own factory, he can find out how much is involved by having such orders filled by an outside firm prepared to handle this type of work. The full cost can then be billed to the sales department. The sales manager would thus find out just how much he is giving away, and could compare it with the amount of business gained as a result. In most cases, under conditions prevailing today, he would probably come to the same conclusion as the shop superintendent already has, that there is no money in the plan for his company.

—L. E. MARKEY, *London, England.*

Handicapping Salesmen With Wrong Information

Salesmen should be informed at once, by some systematized method, of any change in design of the products they are handling. This can be accomplished by employing a clerk to keep records of the products manufactured, and any changes made in the products. This clerk should have records which will show the status of every product manufactured by the company, classified according to type, with copies of the latest drawing of that product in his file. He should also have a list of all employees who receive the drawings, and who should therefore be notified in case of correction. He should then send notices of changes to all salesmen, and other members of the organization interested in that particular product, together with a copy of the corrected drawing of the product, and instructions to destroy the old copy. In this manner, there will be no slip-up, and the buyer will not be given wrong information.

If the sales and engineering departments of a company get together and establish a definite policy of notifying the parties interested regarding every change that goes through, providing it affects the sales, as the size and location of holding bolts did in the case under discussion, the troubles encountered by the salesmen will be largely avoided.

—ARTHUR FRUNCILLO.

Rewards for Suggestions

The success or failure of the suggestion box depends largely upon the method used in conducting the plan. In the organization with which I am connected we have a system that has been very effective for years. The suggestion box is opened at the foremen's meetings and suggestions are read and discussed. The chairman then appoints a committee to investigate their feasibility and report back at the next meeting. Copies of the minutes of the meetings are passed around to the various departments and the employees have access to them. All suggestions made are mentioned in the minutes, together with an explanation of why they are, or are not, adopted.

No direct compensation is given to employees for suggestions. Any employee making a valuable suggestion commands the attention of the management and is eventually rewarded by promotion. There are few impossible suggestions made, but some very important points are brought up. If any of the equipment is in need of alteration and improvement, a note in the suggestion box secures consideration. Suggestions made in regard to safety and working conditions, are always given prompt attention. In this way the management not only gets valuable data, but also retains the good will of employees and secures their full co-operation.—W. J. OWENS, *Foreman. Newport Rolling Mill Company.*

A good way to foster the interest of workers in their jobs, and secure the benefits of the ideas of employees, is through the use of a suggestion system. However, the success of a suggestion system depends upon the way it is pushed by the management, and the assurance given the workman that fair play will be used in the consideration and reward of his suggestions.

An impartial committee should make the awards, the size of the award being in proportion to the value of the suggestion. Giving an award of five dollars for an idea which saves the company a thousand dollars a year will not be very conducive to the success of the plan. However, the workers should be made to understand that many suggestions become valuable only after they have been improved and made workable through the efforts of the company.

Where the value of a suggestion is intangible, a reward, in the form of recognition other than cash, may be appropriate. Suggestions adding to the comfort of employees, but not to the revenue of the enterprise, may be rewarded by a certificate from the president of the company, or by a vote of thanks from the works council.

—FREDERICK KAMPMEIR.

· BOOK · REVIEWS ·

ENGINEERING DRAWING. *By Thomas E. French, professor of engineering drawing, Ohio State University. Four hundred sixty-two pages, 6x9 in. Cloth board covers. Published by the McGraw-Hill Book Company, Inc., 370 7th Ave., New York, N. Y. Price $3.*

THIS is a revised and enlarged fourth edition of a book that has already become widely known as a standard text. It covers the subject in a most comprehensive manner, from the simple problems of lettering, use of instruments, and geometrical drawing to the making of practical working drawings for mechanical, architectural, and structural work.

The book is profusely illustrated with typical drawings, there being more than 700 used altogether. At the end of each chapter a number of problems are given for exercise. The fourth edition has incorporated all of the new standards that have lately been established. There are 22 chapters in the book, which, besides topics directly relating to drawing, include: charts, graphs, and diagrams; shading; duplication of drawings; and notes on commercial practice. An appendix gives a number of standards, symbols, abbreviations, and shop terms.

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DICTIONARY OF AERONAUTICAL TERMS. GERMAN-ENGLISH-FRENCH, FRENCH-ENGLISH-GERMAN. *By J. Vanier. One hundred forty-one pages, 5½x8 in. Cloth-board covers. Published by the American Society of Mechanical Engineers, 29 West 39th St., New York, N. Y. Price $1.65.*

THE international character of aviation makes this little book of special interest to the manufacturer of airplanes. All parts of the mechanism, as well as the terms used in connection with the machine and flying, are given first in German with their English and French equivalents, and then in French with their corresponding English and German meanings. Thus it is made easy to look up the English equivalent of any German or French aeronautical term. The book is of a convenient reference size.

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STEEL CHIPS. *By Idwall Jones. Three hundred twenty-four pages, 5x7½ in. Cloth board covers. Published by Alfred A. Knopf 730 Fifth Ave., New York, N. Y. Price $2.50.*

STEEL CHIPS is something unusual in books pertaining to the machine shop. Written as a novel, it is the story of a boy of fair education, apprenticed unwillingly in the shops of a great works. In a fascinating way the story is told of his four years with shop men and machines. To those who knew apprenticeship twenty or more years ago it is vivid, and to those who know only the shop as it exists since the World War it will give a better picture of some of the things that lay at the foundation of the misunderstandings between management and labor.

All the social scales and bickerings are depicted in a class that was impatient of higher social grades, while on the other hand it pictures the gap that existed between the workman and the older type of general manager, with in-between the "cold constellation of technical superintendents," and below that "other beings who browbeat those at the bottom of the scale." One sees incidentally that the workman's worst enemy was not the fastidious office help, but those in-between who came up from the ranks themselves, and uneducated and unsympathetic they sought to hold their jobs by browbeating, price cutting, and intimidation. Bram Dartnell, the hero of the book, joins in the radical meetings of his shopmates, hates the foremen like many of his fellows, but through it all continues his studies, his drawing, and his mechanical reading. He is picked for general foreman at a critical time because of his knowledge of work and men. Possibly it can be taken as a symbol of the passing of the old order, and the coming of the new where men of education and training and human sympathy filled in the gaps and made possible better understandings between the workers and the management.

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INDUSTRIALS, THEIR SECURITIES AND ORGANIZATION. *By Sterling H. Bunnell. Three hundred thirty-four pages, 5½x8 in. Bound in cloth boards. Published by A. W. Shaw Company, Chicago. Price $5.*

ONE of the author's endeavors, as stated in his preface, is to show that the tangible assets of an industrial corporation may easily be far less important to the prospective investor than the intangible factor of good management. In what he has to say there is nothing new for the industrialist himself, but much that should be both interesting and enlightening to the lay investor. He traces the development of industry as we know it today from its early beginnings, step by step, and he brings out very clearly the new philosophy of industry according to which high wages, larger purchasing power and employee stock ownership have taken the place of low wages, poverty and strikes.

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LABOR MANAGEMENT. *By J. D. Hackett. Six hundred eighty-one pages, 5½x8 in. Cloth board covers. Indexed. Published by D. Appleton and Company, 35 W. 32nd St., New York, N. Y. Price $5.*

BOOKS that try to cover comprehensively as wide a subject as is done by this one are generally crammed with statistics and make, in general, laborious reading, but the author of this book has woven together a remarkable amount of material into a highly interesting and easy-reading volume. Another point to add to its value is that the author has apparently not started out with a hobby to ride or some perverse point to get across and built his story about it. The material is well chosen, and he has attempted to be fair. It is therefore not necessary for the reader to agree with everything in order to enjoy the book and to profit from it.

The volume is divided into thirty-nine chapters, beginning with a general chapter on industry and labor, and then taking up such subjects as: the employment department, the labor supply, selection, interviewing, testing the worker, training, job classification, rating, promotions, turnover, wage determination, payment systems, insurance, and stock ownership. Much of the data is based on the experience of large shops, but is equally applicable to the small shop. Any plant executive can gain something from this book.

A line-up of alarm clocks for the first inspection after the movement has been fitted to the case

PRECISION in a Low-Priced Product

By O. G. WILLIAMS

Vice-President in Charge of Operations
William L. Gilbert Clock Company

THE tieup between modern high-speed production methods and the old traditional handcraftsmanship is strikingly exemplified in the manufacture of clocks. The most difficult problem is to determine—keeping always in mind that quality comes first—just what operations and assemblies can be speeded up, and just where the painstaking handwork and adjustment must be retained. The work divides into two divisions.

In the making of the parts themselves, wheels, pinions, frames, etc., modern production machinery is used. At the William L. Gilbert Clock Company we are constantly in touch with the makers of presses, screw machines and special machinery for ways to increase production either by increasing the speed or by a combination of operations. We maintain an engineering staff which constantly studies operations in the factory, and under their supervision we have constructed in the past three years more than forty special machines which we would have been unable to buy except at much higher cost.

However, no machine, no matter how special or skillful, can replace the experienced clockmaker who performs the delicate adjustments that insure the proper operation of the finished product. The Gilbert Clock Company takes considerable pride in the fact that it is not only the oldest clock company in America but also the oldest company in America of any kind still operating on its original factory site. Clocks have been made here on this location since 1807, over one hundred and twenty years ago.

Naturally, with such a substantial background for the company itself, there are a great many employees whose years of service range from 30 up to as high as 66 continuous years. It is our policy to give a watch, suitably engraved, to each employee who has completed 50 continuous years of service, and it is interesting to note that in this past year alone, six of these watches have been presented.

The most careful operations of

Fig. 1—The first operation on the case of the alarm clock is to blank and draw on a heavy toggle press, after which the part is trimmed and centered. The material is strip brass 8¼ in. wide x 0.015 in. thick.

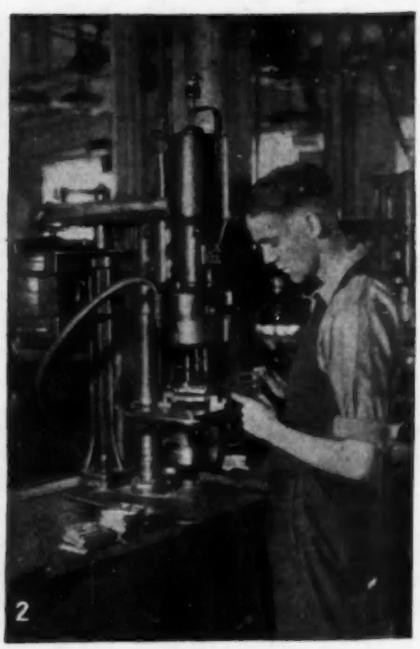

Fig. 2—Multiple drilling the frames used in an ordinary top-bell alarm clock movement. All holes are drilled at once with the aid of a multiple drill head and a single jig

Fig. 3—Poising the balance wheel. The wheel and staff assembly is held in hardened steel bearings and statically balanced by drilling out material on the heavy side

Fig. 4 — Vibrating the balance wheel. The wheel on the right is the master wheel and the new one must oscillate with exactly the same period as the master. If it does not, the operator lengthens or shortens the hairspring until both wheels agree

Fig. 5 — The dial is fitted over the movements and the hands are staked in place by hand as shown

Fig. 6—Final inspection for time, alarm and surface defects. For time these clocks must agree with the master clock, shown in the box at the left, within 2 minutes in a 24-hour run. One of these trucks holds about 600 clocks, and they travel this way from department to department

clockmaking require years of experience and these old-timers, still handling their operations with the same characteristic precision that has marked their work for years, form an instructive background for the younger men whom we are training to that same degree of careful skill.

We have found that high quality, controlled and maintained by a large and flexible inspection division, is one of our best assets. Not only has it built and kept for us the good-will of our customers (and sales division), but it has pointed the way to improved manufacturing methods and lower production costs. High rejection percentages from any one of several inspection locations are an immediate red flag. When rejections are persistently repeated, a change of method, material or personnel is indicated, and there can be no doubt of the responsibility when the inspection reports have located it so definitely.

In this connection a word about tools and toolmaking will not be amiss. We maintain a large and highly skilled tool and machine department at all times, because we have found that, as a broad generality, tool and production costs are inversely proportional. By that I mean that a tool which does two or three operations at once, with a resultant saving in production costs, is very likely to cost more than the tools to do the same operations separately.

Mass production of a low-priced product is too frequently reckoned as just a machine job. The author of this article shows how human skill in production operations and inspection is as important as machines

Every one of the 103 parts that go into one of these low-priced, so-called "top-bell" alarm clocks must first pass the inspection of the basic department in which it originates and then be passed on for general inspection, where it is gaged and inspected before being passed to the assembling departments. There are twenty-five distinct inspection operations on these parts before they finally become a clock, and many more after that.

There is a tremendous fascination about clock-making that is bound to get under the skins of the men and women who work at it. Starting with inanimate raw materials, bit by bit, operation by operation, an article is produced that, in its tick, has life. And a skilled clockmaker, just by listening to this tick, can tell whether or not a clock is performing as it should.

No attempt will be made at this time to explain in detail the mechanics of clock production. Fundamentally they do not differ much from those of any number of other plants, although the problem of doing about 400 distinct operations on 103 separate parts in an article that retails for less than $1.00 is by no means a small one. While it is true that our alarm clocks sell at a ridiculously low price, yet they are not carelessly or cheaply constructed.

Suppose we take one of the most vital parts of this particular clock—the balance staff, for instance—and follow it through from beginning to end. This little part carries the balance wheel and hairspring one and a half turns back and forth at the rate of 345,600 times per day, or 126,144,000 times per year, yet we have faith enough in the lasting quality of these clocks to guarantee them for a period of one year, and their actual life is very much longer than this.

The balance staff is ground to a sharp point at both ends and is milled on a special machine designed for that purpose. It is then washed and hardened in charcoal, and after hardening is again washed and the charcoal blown out. It is then drawn in oil and tumbled. It is now ready to be returned for grinding a second time, to insure a perfect surface. At the completion of this grinding it is again hardened, washed, and the charcoal blown out. Then it is drawn once more and tumbled, after which it is carefully inspected before the wheel and hairspring are driven on. This makes a total of seventeen operations, but the piece is still not yet ready to be fitted into a clock.

Let us consider another part of a different nature—the case. This part is made on the heavy toggle press shown in Fig. 1 and is blanked from brass strips 8⅛ in. wide x 0.015 in. thick. The first operation is to blank and draw, after which the case is trimmed and centered. The cases are then placed in large crates and taken to the buffing department where the sides are cut down eight at a time on a special buffing machine. This operation is followed by a hand operation of cutting down the nose on the front edge of the case, in this particular instance one piece being handled at a time. After this hand polishing the cases are ready to be washed and nickel plated and then returned for coloring in nickel.

All cases are packed 100 in a crate and then sent to another department where they are pierced for bell post and feet. Before leaving this department, however, the feet are riveted in, the bell post staked, the top bell fitted together with ring head and ring, and the glass and mat put in place. There is then a general inspection of the parts concerned before the case is passed on to the fitting department where it finally becomes a clock.

Another example of inspection routine is given in the treatment of the completed movement. Upon completion of the movement the assembling department oils and gives its first test and inspection. It is then carefully packed and passed on to another department where the dial and hands are fitted. Here again it is tested for both time and alarm and run over night. In the morning an inspector goes over these clocks and picks out any that may not be up to standard. Again they are passed on to another department for final inspection where they are sifted down to only those we are sure will meet with satisfaction.

Material plays an important part in both production and quality. We are never satisfied by simply saying that a certain part must be made of brass, but we actually try other metals as well and also various mixtures of brass. In this way we decide the proper material for our clocks not only from a quality standpoint but from its workability and the life of the tools.

By far the greatest part of raw material used in the manufacturer of these alarm clocks is brass and steel. Wide variations occur in temper and mixtures so that a daily check-up is necessary.

Rather than use an arbitrary standard of hardness, for

instance, for passing on raw materials we prefer to test them under conditions of actual use in the parts for which they are intended. Naturally, these tests are further supplemented from time to time by machine tests and microscopic examinations, but we have learned from long experience that the characteristics of certain materials when blanked or machined give a direct indication of their suitability for certain functions.

An example of this would be in the case of a part which is blanked and bent with, say, a 90-deg. angle. Naturally, we know what mixture or temper to specify for such a part, but, when the material is received, the first test we actually make is to blank some of the parts and bend them. This proceduce tells us immediately whether or not the material is usable, and if it is usable, regardless of its meeting exact specifications, we use it. Of course, we almost never find that our specifications are not being followed accurately. In fact it is one of the marvels of this present day that a buyer so consistently can and does get exactly what he specifies.

Factors That Increase Reamer Life

By Herbert M. Darling
Engineer, Wells Tap & Die Company

ON A RECENT trip to some of the large plants around Detroit and through the Middlewest, I was impressed by the abuse of small tools which was in evidence in many of the plants.

One of the most perishable small tools in the production shop is the reamer, and it is worth while to analyze the reasons for its short life with a view to prescribing a remedy. The first point, is the inspection of the new tool before use. Whether made in the toolroom or purchased outside, it should be inspected before going into the toolcrib. A new reamer should have as large a diameter as possible, consistent with producing a hole within the manufacturing limits. It should cut close to the high limit without permitting the "no-go" gauge to enter the hole.

Tool grinders often "play safe" by grinding a reamer to the mean of the tolerance in order to prevent it cutting an oversize hole, and this practice increases the frequency of reamer replacement. Sleeves and sockets used with taper shank reamers are often abused in the shop, causing them to run untrue.

It is a common practice to "stone" a reamer to reduce the size of the hole it cuts, when the oversize is caused by the misalignment of the tool or the machine driving it. Where a spindle runs out, and the reamer is stoned down to cut the proper size hole, it may be used the next time in a true running spindle, which will result in an undersize hole. Floating holders help to overcome this trouble, and they also lengthen the life of the reamer. Another bad habit of "old timers" is to burr up the front of the cutting edge with a hardened burnishing tool, which makes the reamer cut oversize temporarily, but destroys the real cutting edge. Both stoning and burnishing should be forbidden, as they shorten the effective life of a reamer. As soon as a reamer starts to rub or bind, it should be sharpened before it is worn undersize or spoiled.

The resharpening of a reamer should be as carefully done as when the tool is first ground. The beveled edge should be ground back beyond the point where the land has worn undersize, so that no binding will occur when it is used again.

Careful handling and storing of reamers to protect their cutting edges is of prime importance. Paper tubes fitted to reamers will protect them from damage in the toolcrib or by lying around in the shop with other tools.

When worn below the manufacturing limit, a reamer may be reduced to the next smaller standard size, but judgment must be used in selecting work for these salvaged tools. Almost any reamer can be reduced $\frac{1}{32}$ in. and still retain plenty of chip room. When reducing the diameter $\frac{1}{16}$ in., however, the tooth clearance may be too shallow for use in steel, so the reamer should be reserved for cast iron or brass. Economy in small tools is the result of care in their purchase, inspection and use. The dimensions of a new reamer should take advantage of any tolerance given on the product. A foreman should discourage any abuse of tools, and insist upon their being resharpened before dullness results in broken tools or spoiled work. Production men should familiarize themselves with the different types of reamers and select the one best suited for each particular job. By doing this, and through the co-operation of all concerned, better reaming, and lower tool and production costs will result.

Small Loans to Employees

CREDIT unions for industrial employees, practically unknown in the United States a few years ago, have spread with rapidity during the last two years, and appear to enjoy increasing popularity both with employers and employees. There are now 800 such combined saving and short-term load plans in use in the United States. The hold which the credit union idea has taken in industry and among employees shows that financial accommodation to small borrowers is not only an urgent need but a wholly feasible and legitimate banking service.

Employers generally are well satisfied with what the credit unions are doing to release employees from questionable credit houses. The credit unions are also potent instruments of further thrift, since membership usually requires the acquisition of shares in the credit union. While the benefit of saving funds which may be relied upon to provide for emergencies or old age is obvious, relief from the more petty annoyances arising out of temporary financial embarrassments of the wage earners is realized as an influence toward improvement in the morale of the working force.

These facts were brought out as a result of a study undertaken by the National Industrial Conference Board, of New York, the results of which were published in a pamphlet entitled "Employee Thrift and Investment Plans."

Welding Instruction in a Technical School

By Ernest L. Lucas
Associate Professor of Mechanical Engineering, Mississippi Agricultural and Mechanical College

RECOGNIZING the importance of oxy-acetylene cutting and welding in engineering, a required course in this work was inaugurated at the Mississippi Agricultural and Mechanical College. The purpose is to give the students of the senior class in engineering, by means of lectures, demonstrations, and practice, the technical knowledge of correct procedure in the preparation of metals for welding, in the technique of practical welding, and the many applications of welded joints in industry.

Only those cutting and welding blowpipes bearing the Underwriters Laboratories approval are used in the course. The equipment, which is shown in the illustration, allows the students practice with the standard types of blowpipes and apparatus.

A corner of the instruction room for giving engineering students practical training in welding.

The course that is given consists of sixteen periods of three hours each. The first hour of each period is taken up by a lecture and demonstration, the other two hours are used by the students in actual practice. Gas, welding, and flux records are tabulated, and the cost of each job is figured by the students. The class is divided into groups, each group being assigned to a certain blowpipe each period, in order that the individual student may have practice with every type of blowpipe during the course. Copies of trade papers are furnished the students, as well as various handbooks and manuals on the uses of the equipment. A "quiz" is given at the end of the course, and each student is required to state the choice of equipment he has used and the reasons.

In addition to the necessary practice welds, the students have made many articles of shop furniture, and have repaired articles and machinery for the various departments on the campus.

Two miniature roof trusses were designed and built by one of the classes, one with riveted joints, the other with welded joints. Both trusses were identical member for member, joint for joint. The welded truss weighed somewhat more than the riveted truss but was cheaper. By tests on a standard testing machine the students then demonstrated for their own knowledge how the welded structure was more than twice as strong as the riveted one.

Our experience indicates that instruction in cutting and welding has its place in the curricula of the engineering schools today. The knowledge and practice gained from such courses make the young engineering graduate familiar with the fundamentals of correct procedure control. He is capable of inspecting welding and welded materials, and of doing the work himself.

In the structure that was tested, failure of the riveted truss occurred with a load of 14,700 lb. when supported 3 in. from each end. The cause of the failure was the tearing out of the bottom chord in front of the rivets. Whether this failure would occur with full-sized members is not quite certain because there would be a greater amount of metal between the rivet holes and the edges of the members. This problem is given here, not as something new in mechanics, but merely to show how the course is designed to get the students thinking and working along the practical lines of the machine shop.

Painting Safety Guards Red

By F. F. Greely
Asst., Shop Practice, Kansas State Agricultural College

MANY shops erect safety devices around belts and gears, and machine manufacturers provide guards on their apparatus. But why stop with that? If you approach a railway crossing and see a red signal, you instantly look for danger. At street crossings the red signal tells you that if you disobey traffic rules you are in danger. The red tail light on an automobile likewise tells you that there is danger ahead if you crowd too close.

Therefore, why not paint safety machine guards bright red? If there are gears, cams, belts, levers or any moving part in close quarters, there is danger to the operator. Experienced operators become careless, and inexperienced operators become curious. Any person seeing a red painted guard in contrast with the rest of the machine, will instinctively connect it with danger.

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions at the foot of the page have been prepared

THE · FOREMAN'S

Radio in the Shop

"HERE'S a new one for you to think about, Ed. Did you hear what the boys in Joe Kasper's department over in the Newton shop did last month?"

"Guess not, Al. Did they pull off a raffle or a prize fight?"

"Way off the the track, Ed. They've put in a first class radio."

"Well, what do you think of that, Al? Seems to me it's a crazy notion. I'm surprised the management stands for it. Doesn't it interfere with the work and slow down production? How can the men keep on the job and listen to radio at the same time?"

"It's a cinch that if it cut production it wouldn't have lasted a week, Ed."

"How did they get it, Al?"

"The men clubbed together for it after the management had given consent. Guess they were a bit dubious at first, but Joe says they're satisfied now that it's a good move. They may even put one in other departments."

"I still don't see how it can help interfering at times, Al, if not all the time."

"It's quite likely that someone has got to use horse sense in selecting the programs, Ed. I can imagine that jazzy music wouldn't help the man on a fine assembly job and that a dirge might slow down the man on a hand turret. Then, too, I'd be a bit afraid of letting in a detailed account of a championship series ball game, although final scores might be all right."

"Seems to me you are condemning it yourself, Al. What's the use of it anyhow if there are so many objections?"

"Production, Ed, production. Joe tells me it has actually speeded up the output in his department. Music helps to break up the monotony of repetition work and makes things go more smoothly. The time seems to pass quicker, too.

"Joe says they got the idea from a fellow who used to work in a cigar factory. In the pre-radio days the cigar makers used to hire a 'reader' to read to them while they made cigars. When the talking machines came in they used them for part of the time. And then came radio and the 'reader' lost his job in most cases."

"But cigar making was all hand work, Al, and no machine noise. I'm sure the average machine shop noise will play hob with any music by radio."

"I'm not advocating it as a hundred per cent wise scheme, Ed. I'm only giving you something to think about. Joe says it's worked out well in his department. And I'm not sure that it hasn't some good points for almost any place in the shop."

Is Ed right in feeling that radio will disturb men?
Or has it possibilities in relieving monotony when used judiciously?
Or would it be impossible to select a program that might fit all?

Idea contributed by Edward V. Piranian, The Edw. G. Budd Manufacturing Company

All foremen are urged to discuss these questions vital to their work; of course the dis

ROUND · TABLE

DISCUSSION OF EARLIER TOPICS

Keeping Posted on New Tools

THE foreman who neglects to inform himself on the latest developments in his particular field is passing up one of the vital requisites for advancement.

This applies to tools as well as methods. In many instances it is the foreman who suggests the purchase of a new tool or machine. The executive to whom he applies may not always be in a receptive mood, and a great deal may depend upon how much the foreman knows about his subject, indeed it may be the deciding factor. In this competitive age it is a case of keeping abreast of the times or make way for those that do.

—L. B. JONES, *Shop Foreman. Schlage Lock Company.*

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Should We Buy Tools by the Pound?

PROFITS are not made by hoarding money, but by judicious spending. Tools are bought for the things they will do, and to be economical must work as continuously as possible. Since every charge made against a tool during it's useful life constitutes a part of it's total cost, a low or high first cost may not amount to much of the aggregate sum. The tool having the lowest total cost in money, time and trouble per unit of production is the most economical, regardless of the first cost. The most effective way to cut costs of production is to save every second or minute that it is possible to shave off each operation. This can only be done by using tools which will stand a little faster speed, a little heavier feed and last longer between sharpenings, thus producing more work in the same time and lessening the number of shutdowns for tool grinding and adjustment. Therefore, cutting tools for production should be bought because of results, and not on price alone.

—L. O. BROWN, *Toolroom Foreman. Holcomb & Hoke Manufacturing Company.*

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Letting a Big Order Go Elsewhere

THIS idea of filling the shop with strange workmen and expecting to get good work out on time is all wrong. Every company wants to expand and grow, but there are better ways of doing it. As soon as the big order is completed a goodly portion of the newly hired men have to be laid off, which means a considerable loss for their training. These flashes of boom business and subsequent layoffs are the beginning of the end for many a concern that is doing well, without them.

If the plant is busy the big order should be allowed to go elsewhere unless sufficient delivery time can be obtained to allow the organization to assume the new work gradually. The sound way to expand is to add new help gradually, first being reasonably assured of their qualifications, and then working them into the organization by intelligent supervision and example.

All new business has to be estimated, and a price quoted. How can anyone give an intelligent figure on new business when he does not know what the organization behind him can produce? Estimating the efficiency of unknown new employees is impossible, hence the impossibility of estimating the price on a new order, if it entails sudden and temporary expansion.

—FRANK BROWETT, *Triangle Tool & Die Company.*

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Picking Men in Cheerful Surroundings

I LEAN a little toward Ed's idea that it is a waste of money to fit up an attractive room in which to hire men, although I admit that there is much to be said on both sides of the question. The average factory employee feels more at home, and, therefore, is more at ease in familiar surroundings. If the room is to suggestive of an executive office, he is likely to feel out of place, and want to get out of the unfamiliar surroundings as quickly as possible. Cleanliness and orderliness are desirable, but beyond that, the reform is questionable.

I also think that Ed will get better men if he "looks them over" before they are hired. A practical question, based upon a man's past experience will sometimes disclose more, in a minute, than a half hour's routine interviewing. Also, if the foreman accepts a new man, you may be certain that he will receive proper instructions and a fair trial before he is recommended for discharge, which often is not the case if a man is thrust upon the foreman.

—JOHN T. THOMPSON.

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Re-hiring Old Employees

THIS question of re-hiring old employees has always been a ticklish one. There is no doubt but what there are times in any organization when the temptation to go out and get a former employee as the ideal man to fill a vacancy is strong. But, if in so doing, you are penalizing the men who stayed with the firm, it is bad for morale, and no matter how good the man that returns may be, the aggregate result of such a transaction is likely to be a loss. This is particularly true if the man re-hired is taken back at a higher rate than he had when he left the organization. After all, loyalty is something which should be paid for in hard dollars and cents, as well as in compliments which have no cash redemption value.

On the other hand, circumstances do create exceptional

discussion is not limited to foremen. Letters accepted and published will be paid for

cases. Where turnover has been excessive, so that logical candidates are lacking in the organization, or where the former employee possesses some unusual characteristics or experience not to be found within the organization, the practice may be justified.

—STANLEY J. GUSTOF.

THE old employee, Jack, has undoubtedly gained valuable experience in other shops, which in addition to his previous knowledge of the methods of this particular shop, qualify him to fill the vacancy efficiently, and if none of his old "buddies" were left he would certainly be a good man for the job. But under the circumstances, unless William has balanced his "pro and cons" carefully, he is headed for trouble. The best William can do, is to bring Jack back into the shop at his previous rating and pay, and treat him no better than he treats the other men. Then, after several months, when Jack has had time to show by his work that he is better qualified for promotion than the others, no one but the chronic "kickers" will object to his getting a boost.

—FRANCIS M. WESTON,
U. S. Naval Air Station, Pensacola.

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Going Over the Super's Head

GOING over the superintendent's head may be justified at times, but it is a rather hazardous thing to do. In the interest of harmony there should be few cases where it is imperative that the highest authority be called into the matter.

The foreman should be frank in his dealings with his superintendent. He should not indulge in personalities, and should take it for granted that everyone concerned in the matter wants to decide the matter on a basis of fact instead of opinion.

It is not advisable, in the interest of shop efficiency, to complain to the general superintendent about the shortcomings or wrong-doings of a superintendent until the matter has been discussed frankly with that superintendent, and then, if there is no agreement, the foreman should go with the superintendent to the general superintendent for a decision and then abide by it.

—JOSEPH BELL.

Ed and Al Agree on Obsolescence

SINCE we are all agreed on the soundness of installing new equipment to replace obsolete units, we should sit down and figure out in advance what the savings will be. It may be possible that in some particular case it will pay to redesign the product in order to make still better use of the new equipment, or possibly, to modify our present equipment in some instances will pay as well as to order new. The act of figuring out the expected savings or increased production will establish a basis against which to compare our final results. We will also have something definite to present to the executive who is expected to approve the purchase of new equipment, as a justification for ordering it. The necessity for so doing may not be quite as apparent to him as to the production man who has recommended it.

—LEWIS J. YAPP.

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Belts, Foremen and Paper Work

THE organization I am connected with handles maintenance costs in what I consider a very efficient manner. Each man on starting a repair job "rings in" and is given a requisition slip with his check number and departmental order number on it. This is presented to the stock clerk with each request for material. The clerk makes a note of all material issued, on blanks provided for the purpose, which are filed, and on completion of the repair work, returned to the machine shop office along with the calculagraph record. They are examined and O K'd by the foreman and in this manner, replacement, repair and labor costs come under his inspection while bookkeeping on his part is reduced to a minimum. This method removes the usual objection

—R. S. ALEXANDER.

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THE · NEXT · TOPIC

"When Do Automatic Machines Pay?"

An Unemployment Fund

SUMMARY OF THE DISCUSSION

Al and Ed discussed the policy of a firm that had set aside a fund out of which it undertook to pay its men a percentage of their regular wages during any period of unemployment due to lack of work. Ed did not disagree with the principle of an unemployment fund, but he was doubtful as to whether such a plan could be applied successfully.

INTEREST in an unemployment fund was not wide, but the opinions that were expressed were constructive. An industrial engineer described an instance where, because the work was of a seasonable nature, the management set aside a fund to be used for overhauling machinery and repairing the plant during the dull season. Another contributor related an experiment that had been tried by a group of manufacturers in Cleveland, who guaranteed their employees 20 weeks' work each half year. If an employer failed to keep a man employed for this length of time, he paid him his usual wages for the remainder of the guaranteed period, regardless of whether the man was working elsewhere or not. An accountant did not favor such a fund, because, he held, some men would refuse to accept money from such a source. At the plant where he is employed, all employees were retained during any slack period and the number of working hours were reduced. Another contributor described an instance where some men voluntarily paid a portion of their piecework earnings into a common fund during the busy season, and drew them out during the slack season in order to average their weekly earnings over the year.

GEAR GEOMETRY

A New Approach to Gear Analysis

By ALLAN H. CANDEE
Mechanical Engineer, Gleason Works

After developing a logical series of definitions for gear elements contained in a single plane of rotation, the author proceeds to examine the third dimension in space geometry

A CLEAR and accurate understanding of the elements involved is indispensable to all who deal with the design, dimensioning, cutting, and measurement of gear teeth. The information here presented has been collected and arranged with the idea of making the important geometrical relationships as easy to see as possible, with the intention of providing a sound basis for a thoroughly logical and comprehensive system of gear geometry.

The accurate exchange of ideas requires the exact definition and use of terms. Nowhere is this true to a greater degree than in the case of the present subject. Therefore, we will begin with a definition.

1. GEARS are machine elements provided with engaging teeth which are of such shape that motion is transmitted in the manner of smooth curves rolling together without slipping.

The rolling curves are called pitch curves because on them the pitch or spacing of the teeth is the same in both of two engaging gears. Here, as in some other branches of mechanics, pitch means interval between members of a series of equally spaced elements, like the pitch of a row of rivets.

A paper presented at the annual meeting of the American Gear Manufacturers Association, May 16-18, in Cleveland. This is the first of two parts.

Usually, of course, pitch curves are circles or straight lines, and the motion transmitted is either rotation or straight line translation at a constant velocity ratio.

When two axes of rotation are in the same plane, we have pitch surfaces corresponding to the pitch curves. The pitch surfaces, like the pitch curves, roll on each other and in addition are tangent along a straight-line element. Such surfaces may be cylinders, cones, or planes.

These considerations lead up to a classification of the various types of gears, as outlined in Table I. Of course, there are also gears with axes not in the same plane. The special features of such gears will not be dealt with in this paper.

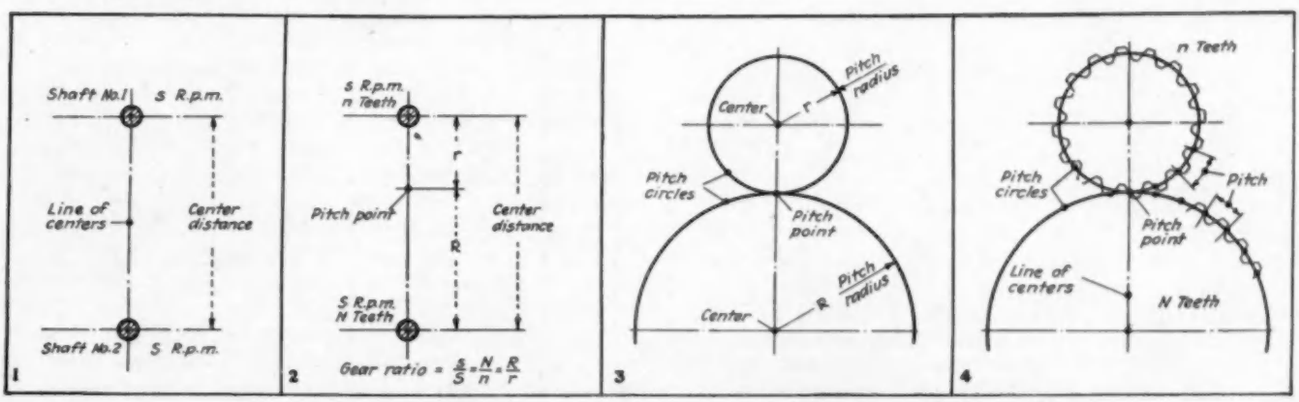
Most of the accompanying diagrams apply completely only to helical involute gears and especially to the corresponding oblique-tooth racks. The relationships between angles, however, are true for any type of gear.

In order to show how it is possible to develop a self-consistent system of gear terms, definitions, and relationships, it is best to start at the beginning and advance step by step. This will seem rather elementary at first, but it is the most satisfactory method to follow.

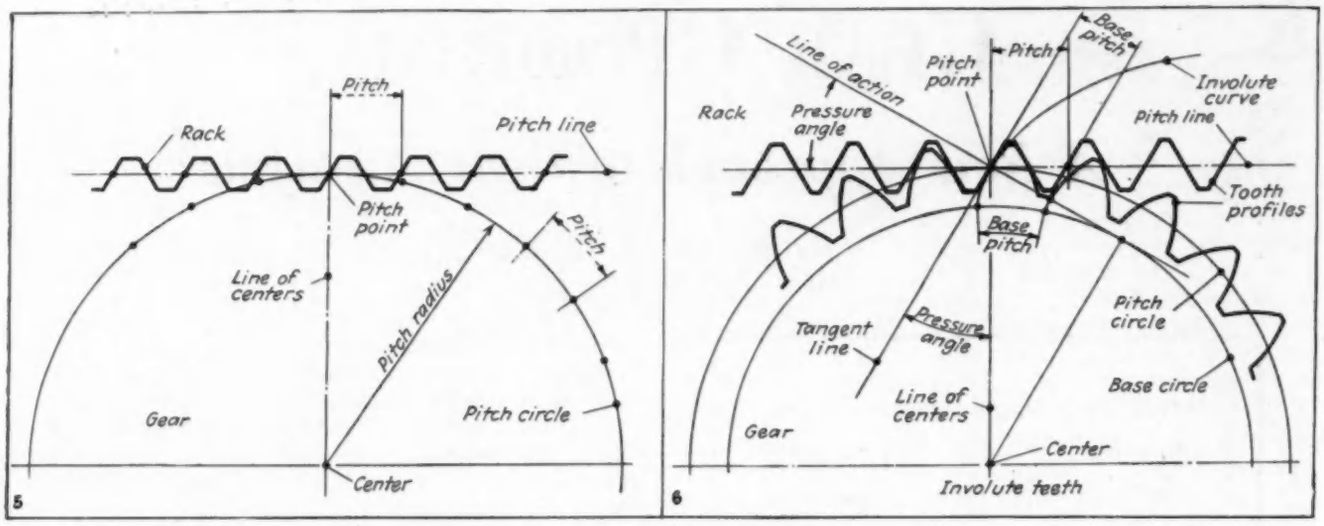
The original gear problem may be stated like this: Given two shafts, their relative position, and the speeds

Table I—General Classification of Gears

Pitch Surfaces	Relation of Axes	Direction of Teeth	Name of Gear
Cylinders	Parallel	Parallel to axis	Spur
		Oblique to axis	Helical or herringbone
Cones	Intersecting	Intersecting axis	Straight-tooth bevel
		Offset from axis	Spiral bevel
Plane	(Rolling with cylinder	Parallel to axis	Spur rack
		Oblique to axis	Helical rack
		Intersecting axis	Straight-tooth crown gear
	(Rolling with cone)	Offset from axis	Spiral crown gear



Figs. 1-4—Step by step development of some fundamental gear terms and relationships



Figs. 5 and 6—Some basic gear elements

at which they are to rotate; to provide a pair of gears which will enable one shaft to drive the other at the required velocity ratio.

2. A PLANE OF ROTATION is any plane perpendicular to a gear axis. The complete geometry for a pair of spur gears can be confined to a single plane of rotation.

3. A GEAR CENTER is the point of intersection of the gear axis in a plane of rotation.

4. The LINE OF CENTERS (Fig. 1) connects two gear centers in a plane of rotation. It establishes directions.

5. The CENTER DISTANCE is the shortest distance between two gear axes. In the case of spur gears, that is for parallel axes, it is the distance between two gear centers in a plane of rotation.

6. The NUMBER OF TEETH is the total number of teeth contained in the circumference of a gear.

7. The GEAR RATIO is the ratio of the number of teeth in two engaging gears. It is also the ratio of the gear speeds and of the gear diameters.

8. The PITCH POINT (Fig. 2) is on the line of centers and divides the center distance into two parts proportional to the gear ratio.

9. The PITCH CIRCLES (Fig. 3) of two engaging gears, pass through the pitch point, are tangent to each other, and roll together without slipping.

Definitions 8 and 9 refer strictly only to gears with axes in the same plane.

10. The PITCH LINE (Fig. 6) passes through the pitch point and is perpendicular to the line of centers. It is the line in the rack that rolls with the gear pitch circle.

11. The CIRCULAR PITCH (Fig. 4) is the distance on the pitch circle (or pitch line) between similar sides of adjacent teeth. In order to save time and space, circular pitch will be referred to in this paper simply as pitch.

12. A TOOTH PROFILE is the curve forming the side of a tooth section.

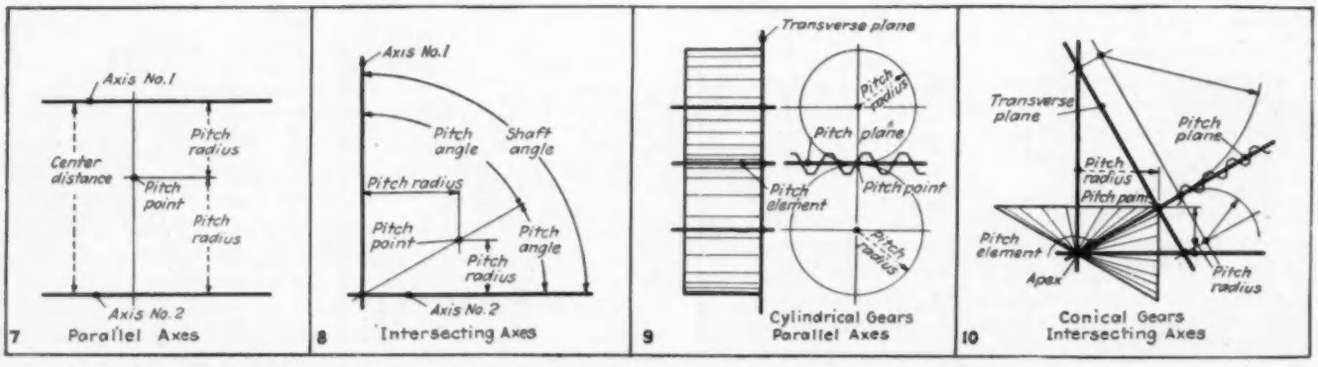
13. A POINT OF CONTACT is the point at which engaging tooth profiles touch each other.

14. The LINE OF ACTION (Fig. 6) passes through the pitch point and is normal to the tooth profile. It is the line along which the tooth pressure acts. With involute tooth profiles the line of action is also the path of the point of contact.

15. The PRESSURE ANGLE (Fig. 6) is the angle between the line of action and the pitch line. The pressure angle is so named because it indicates the direction of the pressure or force between engaging teeth. It also indicates the inclination of the tooth profile with respect to the pitch circle, and at the point of intersection of any tooth profile and the pitch circle it is the angle between the radius and the line tangent to the profile.

16. The BASE CIRCLE (Fig. 6) is the circle from which involute tooth profiles are described, and is tangent to the line of action.

17. The BASE PITCH (Fig. 6) is the pitch measured on the base circle. Involute curves with the same base circle and of the same hand are parallel curves, and base pitch can be measured on any line of action tangent to the base circle. In an involute rack similar sides of the teeth consist of a series of equally-spaced parallel lines,



Figs. 7 and 8—Development from two parallel axes of the case of two intersecting axes corresponding to bevel gears
Figs. 9 and 10—The analogy between cylindrical and conical gears carried further, showing the location of the transverse plane and the pitch plane in each case

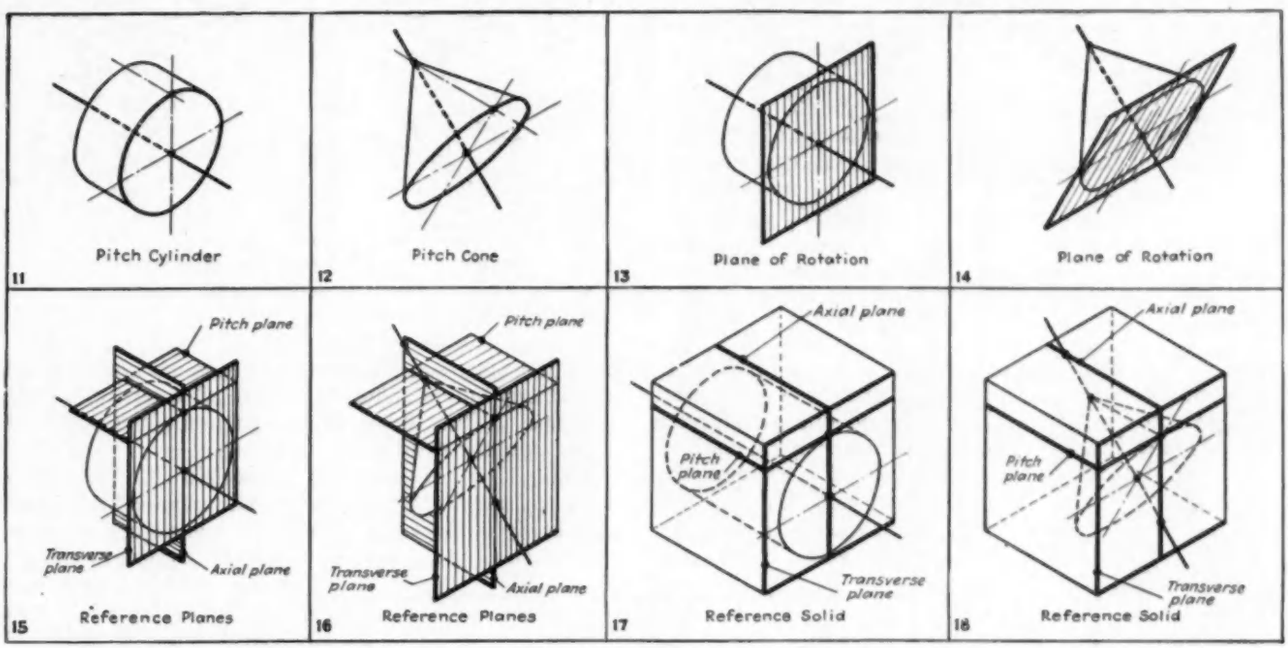
and the base pitch is the perpendicular distance between such lines.

Attention is now called to the way in which the foregoing definitions form a logical series, advancing one step at a time, each definition being based upon those which preceded it. The result is a fairly complete description of the geometrical elements involved in gear teeth. Except perhaps for the method of presentation there is nothing new in this list of definitions. The elements which have been illustrated and defined are found referred to in various text books dealing with gears; but it should be noted that all the terms so far considered are contained in a single plane of rotation. In other words, only plane geometry has been involved. The detailed information given in text books usually stops at about pitch point with the point of intersection of the gear axes. In the case of parallel axes, which meet at infinity, the pitch element is parallel to them. The pitch element is an element of the pitch surface of each gear, and is the line of tangency between two pitch surfaces.

19. The PITCH PLANE is tangent to the pitch surfaces and contains the pitch element. It is in fact the pitch surface of the rack or crown gear.

20. The TRANSVERSE PLANE is perpendicular to the pitch element. Also, of course, it is perpendicular to the pitch plane. In the case of cylindrical gears the transverse plane and plane of rotation coincide; but with conical gears they are separate.

In Fig. 10 the points of intersection of the gear axes in the transverse plane are virtual centers, and the circles



Figs. 11-14—A pitch cylinder and a pitch cone with their respective planes of rotation. Figs. 15-18—Principal reference planes applying to a pitch cylinder and a pitch cone

this point. It is the relationships lying beyond, when the third dimension in space is considered, that it is proposed to examine.

One of the next steps in order is to recognize the direct analogy between spur and bevel gears. This analogy can be easily overlooked by those who deal with only one form of gear; but it becomes very useful when developing a general system which is as far as possible to be capable of application to all types of gears.

In Fig. 7 is illustrated how in the earlier diagrams we started with two parallel axes separated by a given center distance. In Fig. 8 there is the exactly corresponding case for bevel gears, that is, two intersecting axes separated by a given shaft angle. Quite as before, the pitch point is located so that the radii of rotation about the respective axes, meaning of course the pitch radii, are proportional to the gear ratio. Then the line connecting the pitch point to the point of intersection of the axes divides the shaft angle into the two respective pitch angles. Definitions for the special elements in bevel gears can readily be constructed; but we will consider in this paper only definitions of terms which have general interest.

18. The PITCH ELEMENT is the line connecting the struck from them are virtual pitch circles. The process of laying-out gear teeth in the transverse plane, however, is the same for bevel gears as for spur gears. This similarity makes possible a general system of reference planes which can be adapted to all possible cases.

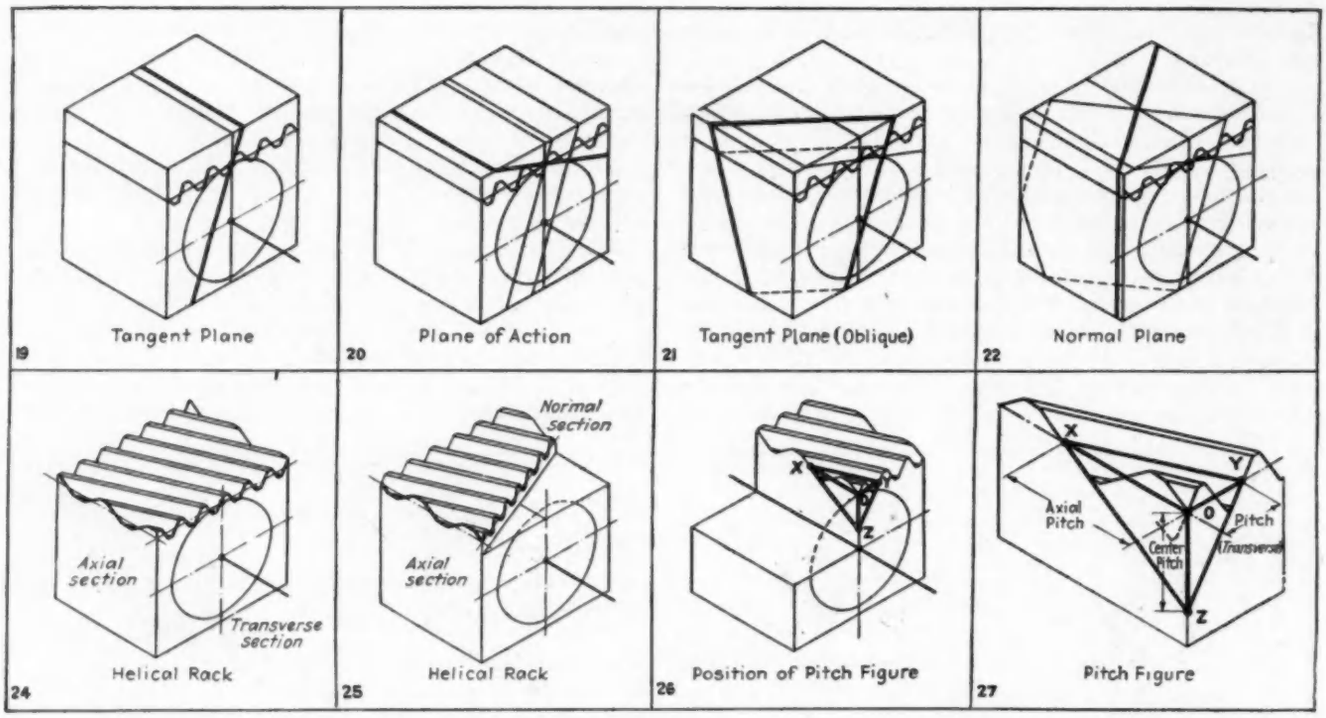
Figures 11 to 14 illustrate a pitch cylinder and a pitch cone, with their respective planes of rotation, and require no explanation.

Figures 15 to 18 show the important principal planes suitable for application to any form of gear, and to which all angles and directions are to be referred. In addition to the pitch plane and transverse plane already described, there is a third reference plane.

21. The AXIAL PLANE (Figs. 15 and 16) contains the gear axis and is perpendicular to the pitch plane.

These three planes are all mutually perpendicular, and it should be observed that they correspond to the three reference planes always used in mathematics for locating position in space.

22. The TANGENT PLANE is tangent to the tooth surface at a point of contact with an engaging tooth. With involute teeth the tangent plane is actually the side of a tooth in the rack; and its intersection with the transverse plane is the line forming the side of a tooth of the trans-



Figs. 19-22—Use of space box to aid visualization of the tangent planes, plane of action and normal plane. Figs. 24-27—Step by step development of the pitch figure from oblique involute rack elements.

verse rack section. The tangent plane may be parallel to the pitch element, corresponding to straight or spur teeth, as shown in Fig. 19; or it may be oblique to the pitch element, as in Fig. 21, indicating helical or spiral teeth.

23. The PLANE OF ACTION (Fig. 20) contains the line of action in the transverse plane and the pitch element in the pitch plane. It is perpendicular both to the transverse plane and to the tangent plane. In the case of a cylindrical gear the plane of action is parallel to the axis. It is tangent either to a base cylinder or a base cone.

24. The NORMAL PLANE (Fig. 22) is perpendicular to the pitch plane and to the tangent plane, that is, it is normal to the tooth. In a cylindrical gear with helical teeth the normal plane is normal to the helix on the pitch cylinder, and in spiral bevel gears it is normal to the tooth spiral on the pitch cone or in the pitch plane of the crown gear.

It is now time to point out that for every element in the plane diagram of Fig. 6 there is a corresponding space element. This is illustrated in detail in Fig. 23. For every point in the transverse plane there is a corresponding line in space, and for every line or curve in the plane there is a corresponding plane or surface in space. In the case of a cylindrical spur gear all such planes and surfaces are parallel to the axis, and all transverse sections are identical, so that any one is sufficient to give all geometrical relationships. When, however, the tangent plane is oblique to the axis, the case is not so simple.

It should not be necessary to explain that the dimensions and angles for involute teeth can be determined most easily in the rack. These dimensions are the same in the rack as in a gear, and the rack is composed entirely of planes, which makes it comparatively simple to diagram and calculate the elements.

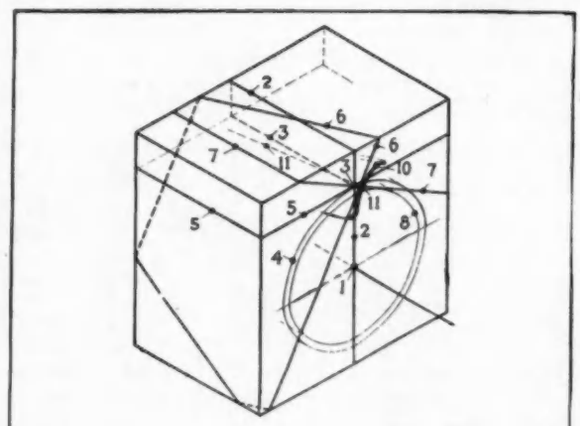


Fig. 23—Chart showing that for every element in the plane of rotation there is a corresponding space element

In Figs. 24 and 25 the three principal rack sections are illustrated. The transverse section is the one usually considered for gears. Worm-thread design is usually based on the axial section. In any oblique-tooth gear the normal section is of important interest. In all of the three principal planes, which are the

transverse
axial and
normal

there are corresponding rack sections and elements. For instance, in each plane there are

a pitch line
a tangent line
a line of action
pressure angle
pitch
base pitch, etc.

all of the linear dimensions, which, as is seen, consist of pitch values, and all of the angles involved in the various

involute rack sections can be combined into a single space figure which is here called the "pitch figure." The position of this figure in relation to the reference planes which have been established is shown in Fig. 26, and in Fig. 27 an enlarged view is given.

A correct and complete mental picture of this pitch figure can be obtained by giving attention to the following facts. In the involute rack similar sides of the teeth consist of a series of equally-spaced parallel planes; and in any plane or section the rack outline is formed by corresponding series of equally-spaced parallel lines. Each of the pitch values which have been referred to above is simply the distance between two of these parallel lines, or parallel planes, taken in some definite direction. Thus, in Fig. 27, point *O* lies in one of the parallel planes of the rack, and points *X*, *Y*, *Z*, lie in the next parallel plane back of it. In the transverse section *OY* is the distance in the direction of the pitch line between two of the parallel tangent lines, and is the pitch of the rack teeth. Similarly *OX* is the distance between the same two parallel planes taken in the direction of the pitch line in the axial section, and so is the axial pitch. The pitch between the parallel planes indicated as *OZ* is in the direction of the lines of centers and is perpendicular to the pitch plane. It is here named the center pitch.

A Wage Bonus System That Failed

By P. H. Bryant

WHILE doing special work for a large manufacturer of special tools, the writer had opportunity to watch the installation and operation over a three-year period of a wage bonus system in a plant employing only toolmakers and their assistants, a class of employees doing work of a nature that does not readily lend itself to any of the existing systems of bonus payment. In this particular case, some outstanding defects have come to light which no executive has fully recognized, or, having recognized, has succeeded in ironing out. The experience is given here in order to illustrate the pitfalls that may arise in any shop unless care is used.

The particular bonus system tried out used "Bonus Hours" and an average labor efficiency of 75 per cent as the basis of computations. In theory, a perfect workman could do the job in the bonus time: In practice, however, no employee or group of employees was expected to complete the work in the estimated or bonus time, but should fall short of performance in that time by as much as his efficiency as a workman was less than 100 per cent. The operative or group was rated as performing above average proficiency in proportion as they reduced the elapsed production time below 100 hours, for example, where the bonus time was 75 hours. For the hours so saved a bonus was paid equivalent to the number of saved hours times the operatives full hourly rate. No penalty accrued for taking more than 100 hours.

The most serious and costly defect that has developed from the installation of this bonus system is found in its psychological effect on the workmen involved. Instead of inspiring the workman to co-operate with their employers to the end that both should profit from accelerated output and improved quality, it has given rise to various schemes to make the system a source of gain for the workman at the expense of the employer. Since the system has been in operation, there has been a definite lowering of the average efficiency of the average employee, but this change has been so gradual that even the workmen themselves have failed to realize it.

The thing that started average efficiency on the downgrade was the fact that at the outset only a part of the work was put on bonus and certain classes of jobs on which it was particularly difficult to make accurate estimates as to the possible time required were put through on a straight hourly basis. Immediately there developed the practice of working at normal rate or slightly better on a bonus job, but of laying down without reason or conscience on straight day work. This ruse soon became apparent and the answer to it was to put all jobs on a bonus basis.

A second influence that helped along the slowing down process had its source in the group bonus. Few jobs were completed with less than six men taking part in its processes and often there were fifteen or twenty workmen in the interested group. Unfortunately, hardly two workmen have the same mental characteristics or point of view. One workman might be of a temperament that responded to the bonus stimulus and the other not, so that the booms of the first might be entirely cancelled by the disinterestedness of the second. The net result is that the first soon also loses interest.

As a result of these slowing down influences the better class of operators now work on jobs on which they feel sure of a large bonus at about the rate and with the same degree of concentration that they previously put forth on straight day work, while in work that holds no hope of a bonus all classes kill time and relax interest to an extent that affects very unfavorably both the quantity and quality of output.

Another defect was that the workmen soon found that it was poor business on their part to work for a large bonus on any one job because it was certain to be followed by a reduction of the bonus hours on the same or similar work the next time it came into the shop. The men even adopted the expedient of swapping time, that is, of charging work done on one job to another job where in the first instance too much time was being consumed and in the second too little, under the bonus system.

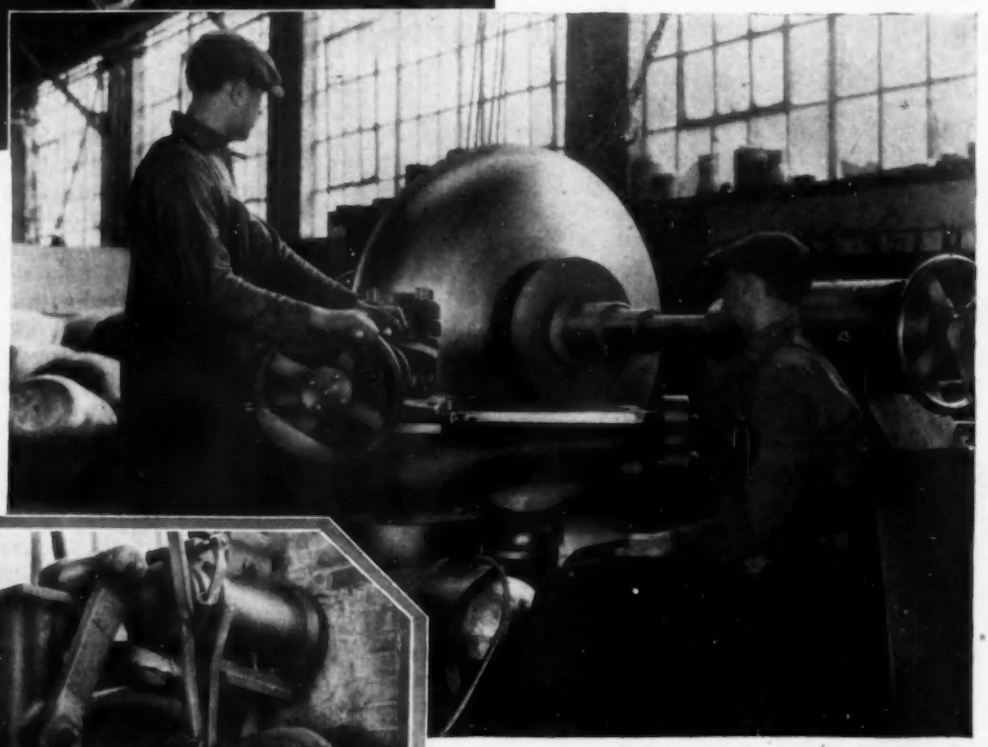
One of the most important of the defects noted is the incentive offered by the system to rush work without regard to the quality of the workmanship or product. Opportunities for slip-shod methods are particularly prevalent where jobs include not only the machining of a number of parts but the assembly of those parts into a mechanism designed for a certain purpose.

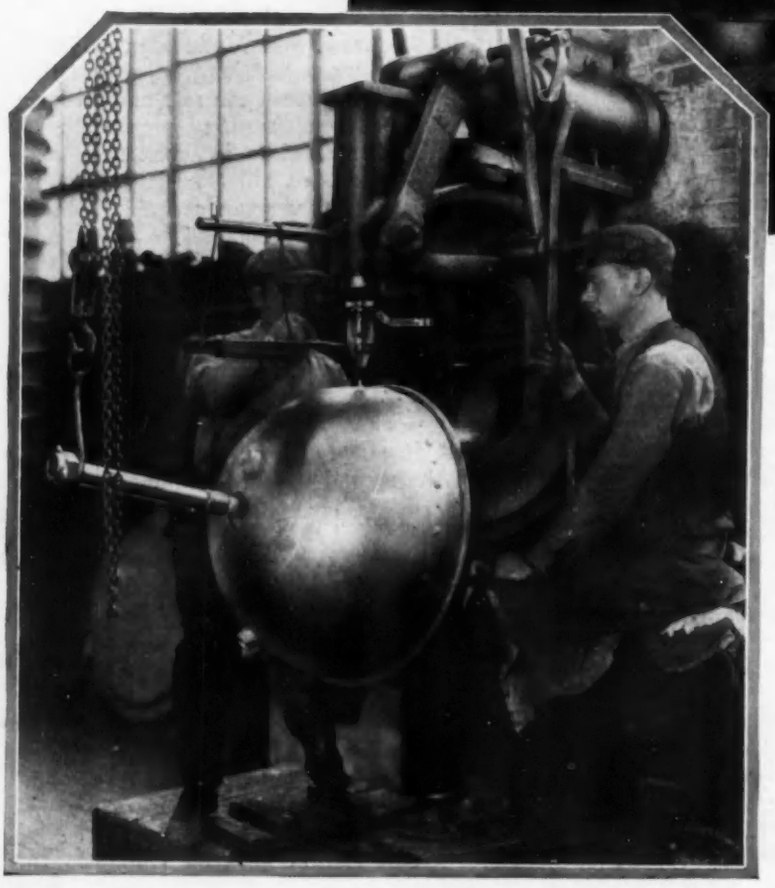
From these observations it is apparent that either there must be some remarkable initial economies in favor of such systems or a remedy must be found for some of the defects that operate to nullify those economies if wage-bonus systems are to prove the final answer in the exchange of compensation between employer and employee.

Spinning A Heavy-

Photographs by courtesy of the Aluminum Company of America

The bottom, and the jacket for a steam-heated kettle, starts with a circular blank cut from the rolled sheet. The thickness of the metal used varies with the size and purpose of the kettle





The steam jacket is riveted to the outside of the kettle. The blank is centered on a pin, and held by two disks that revolve with it. The compound movement of the tool carriage and the revolving table produces the desired shape

The steam jacket is riveted to the outside of the kettle. The shallow one shown is for fruit, or food that must not be crushed while cooking. The rim is spun in a separate operation, prior to riveting

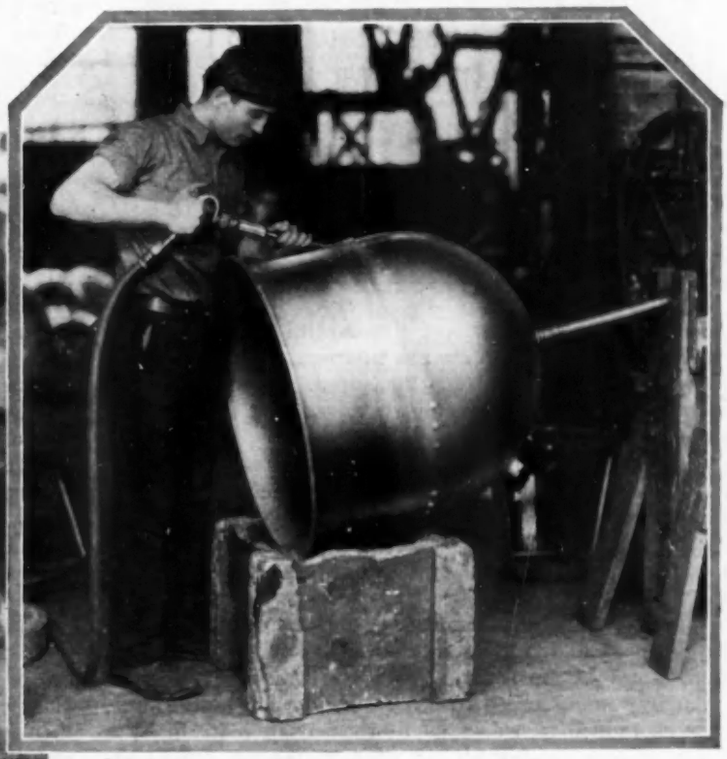
and Welding

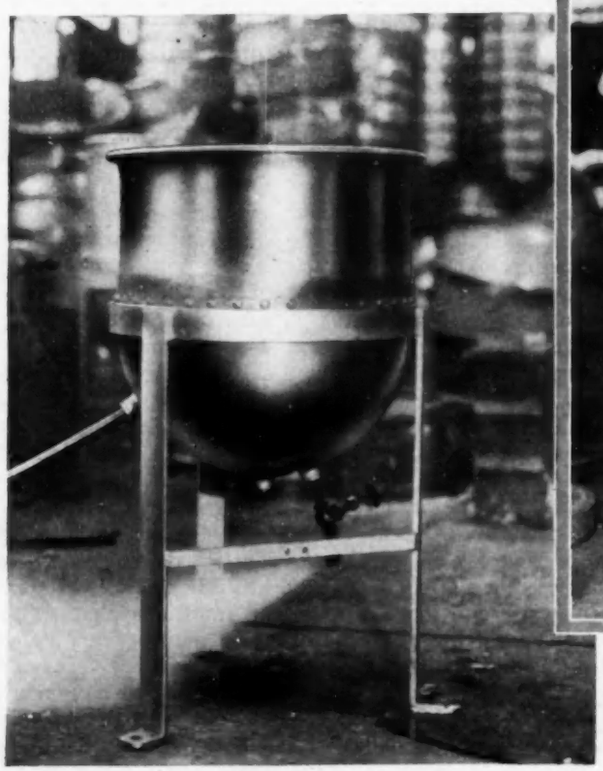
Gage

Aluminum Kettle

Top sections of different heights, and thickness of metal, are welded to standard bottoms. The steam jackets are also welded after riveting to give a smooth surface

After the welding operation, the outer surface is chipped, ground and polished. This allows it to be easily cleaned and also improves its appearance. The photograph shows the chipping operation





The steam jacket is given a test considerably in excess of the 40-lb. pressure at which the safety valve is normally set. After inspection the kettle is given a final grind and polish before it is ready for shipment

German and Skoda Tolerances Compared—*Discussion*

By Earle Buckingham
Associate Professor of Engineering Standards and Measurements
Massachusetts Institute of Technology

IN THE article by Dr. George Schlesinger, stating the German case, which appeared on page 725, Vol. 69, and in the rebuttal by Dr. N. N. Sawin, representing the Skoda Works, on page 397, Vol. 70, of the *American Machinist*, the major point of discussion seems to be around the suitability of the use of a factor based upon $\sqrt[3]{d}$ as a correct tolerance factor. It might be well to observe at this point that this same factor is used in our American Standard as a tolerance factor.

As Dr. Sawin of the Skoda Works points out in his original article on page 721, Vol. 67, the extent of this tolerance should logically be governed by several factors, not all of them being related entirely to the size of the part. The minimum variation in the size of the work which it is possible to control is dependent upon: first, the accuracy to which we can measure, and second, the reliability and consistency of the method of machining employed.

The accuracy of measurement depends upon the accuracy of the observer, the accuracy of the measuring instrument, the accuracy of the control of the physical conditions under which the measurement is made, and the size of the dimension being measured. Even this is not a complete list of the factors involved, but it should be sufficient for our purpose of discussion.

> Even with our present day equipment, the results obtained depend so much upon the mental attitude of the workman that a system that best fits one group of men may be a misfit for another

The inaccuracy of the observer may be a constant for any given instrument. That is, the extent of the observational errors may always be within a fixed range. The extent of these observational errors may vary, however, in the use of different types of measuring instrument.

The accuracy of the measuring instrument itself depends upon many factors, such as its design, construction, size, etc., but for any given instrument its probable error may be assumed to be reasonably constant. Thus, if a change in size or type of measuring instrument is made at any fixed positions of size, the tolerances required to compensate for this factor may vary in abrupt steps. This cannot be represented by any simple factor of the size.

The control of the physical conditions under which the measurement is made relates primarily to the control of the temperature of the work and measuring instruments. If we assume a probable temperature difference of a constant amount, this variation will be directly proportional to the size. But this temperature difference will depend upon the bulk of the part being made, the amount of metal removed, the rate at which it is removed, etc., so that the probabilities are that the temperature difference may be greater with bulky parts than it will be with small parts.

As far as variations in measurements are involved, in general with the expenditure of the same effort, these variations would probably start at some minimum amount with the smallest sizes and increase with an increase in size more or less directly proportional to the size. Actually, however, as the size increases the value of the product usually increases so that relatively more effort is expended in the measurement so that the variation is less than directly proportional to the size.

The reliability and consistency of any given machine is practically constant, except that with bulkier parts, the variations caused by deflection of the work under the strain of the cut reduces with an increase in the size of the part. This decrease, however, is relatively slight. Thus with the same effort, a constant amount of variation must be expected from any given process. Actually, however, as in the case of measurement, relatively more effort is expended on the larger and more valuable product, so that in practice there may be a tendency for this variation to reduce in amount with increase in size.

No claim is made that the factor based on $\sqrt[3]{d}$ has any scientific foundation. A study of actual experience indicated that within the range of sizes studied, tolerances based on this factor represented a fairly consistant practice. It would be manifestly improper to carry out this factor to extreme sizes. Probably the curve representing this factor should have an asymtote, this asymtote possibly representing the temperature variation effects with which we must contend.

The discussion also includes estimates of the cost of reduced tolerances. Given the same equipment, both for production and measurement, the cost will increase with a reduction in tolerances. Yet given a sufficient quantity of work to pay for special equipment, it is almost always possible to develop methods and equipment so that improved results can be obtained at the same or even less cost. Thus the results which today we consider as the best attainable inside of the cost limitations may seem very crude with the further development of improved processes.

After all, to expect complete unity of tolerance standards used in different countries is futile. Even with our present day equipment, the actual results obtained depend so much upon the mental attitude of the workmen themselves, and their customs and traditions, that a system that best fits one group of men may be very much of a misfit for another group. Tolerances are necessary evils. We would all be happier if we did not have them to contend with. Our constant effort is to reduce the necessity for them as much as possible. In the final analysis the answer is: "This is the best we can do."

Connecting Rod Methods *That Are Unusual*

By Fred H. Colvin
Editor, American Machinist

Lynite rods and forged steel caps of the Stutz engine are machined by methods that vary considerably from standard practice

THE connecting rod of the engine made by the Stutz Motor Car Company is a Lynite forging, while the cap is of forged steel. Consequently the usual method of forging the rod and cap in one piece and cutting them apart has no place in this operation line-up. The first operation on the rod is shown in Fig. 1, in which the small end is both located and held by the cone-pointed screw *A* that centers itself in the depression in the rod while the large end is centered sideways by the angular projections *B* on the base of the fixture, under the cutters. The rod is also held against movement by the stop *C* at the end. With the rod clamped in position the table is raised and the sides of the bolt bosses are milled square and parallel by the pair of straddle milling cutters as shown. The only object of this operation is to secure positive locating points for future operations.

A drop-forged steel cap with an aluminum-alloy connecting rod is an unusual combination. The machining operations vary considerably from standard practice, and call for uncommon fixtures and methods

One use of these locating surfaces is seen in Fig. 2, where both ends of the rod are being operated on. With the small end centered and held in one end of the fixture, and the large end centered between the screw in front and a fixed stop at the back, the small end is drilled and the large one is bored ready to receive the babbitt. The illustration shows the type of fixture used, and the way in which the large end boring tool is guided by the hardened strips above the cutting edges.

The caps for the ends of the rods are steel forgings that are made in pairs as shown in Fig. 3. This method permits two caps to be handled at once and makes them easier to hold than if each cap were separate. The caps are also straddle milled on the bolt-boss to provide locating surfaces to fit between fixed stops on each side, one being shown at *A*. The swinging strap *B* permits easy removal and replacement, while the screw in the strap holds the work firmly in place. The substantial boring tool is guided in the bushing, the same as for the rod itself. There is, however, this difference between the two operations, the boring is done from two different centers. In other words the hole is elongated sufficiently to allow for the width of the milling cutter that separates the caps. The offset is obtained by using an eccentric bushing so that the center shifts when the bushing is turned to another position. The top half of the base of the fixture also shifts so as to maintain the alignment.

After boring, the caps are babbitted in the usual manner, the hole being made to fit the mandrel used in the next milling operation, Fig. 4. Six of the double cap forgings are strung on a mandrel as at *A*. The mandrel is flattened on opposite sides and has a keyway in each flat for clearance for the cutters that separate the two two caps. Two fixtures are provided so that one can be loaded while the other set of caps is being milled. The mandrel is held at each end by a strap at a 45° deg. angle, the flattened sides locate the mandrel in the proper position and also act as an indexing face when the mandrel is rolled over, after loosening the binding straps at each end.

The fixture is shown in place at *B* and shows the straddle milling cutters that face the bolt boss seats as well as the slitting or parting cutter in the center. Chips are cleared out of the slitting cutter teeth by the wire brush *C* that is driven by the small electric drill mounted on the over-arm of the milling machine. It will also be noted that the cap forgings are held together by a wedge *D* through the mandrel. This wedge clamps the caps between the collar at each end of the mandrel. Caps are shown on the table both before and after being separated. The babbitt in this case is not cut quite through.

The method of babbitting these rods differs somewhat from usual practice, two rods being put in the centrifugal or spinning machine at the same time, as in Fig. 5. One rod is located at the small end by the stud *A* while the bolt bosses on the large end fit between the plates in the center of the disk. The large end of the second rod butts against the first and is also held by the bolt bosses, while the small end fits between two side supports and is held endwise by a cam on the end of the lever *B*. Then the front plate *C* is swung up over the rod and held by the latch *D*, as shown at the left. The babbitt is poured through the hole in the center of plate *C* using the long spout of the ladle. A spring plunger under the latch holds the plate so that the cross bar in the latch stays in its groove in the front plate.

When removed from the babbitting machine the two rods are together as at *E* but are easily separated, as

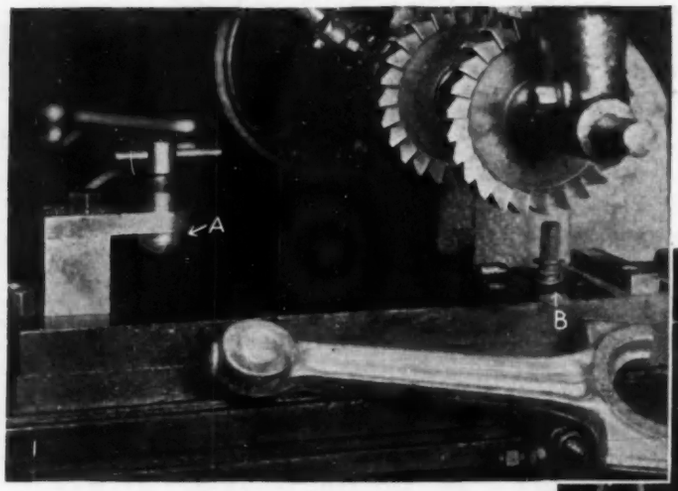


Fig. 1—Forged Lynite connecting rod and the fixture in which the sides of both bolt bosses are milled. The object of this operation is to prepare location surfaces for subsequent operations. The small end is both centered and clamped

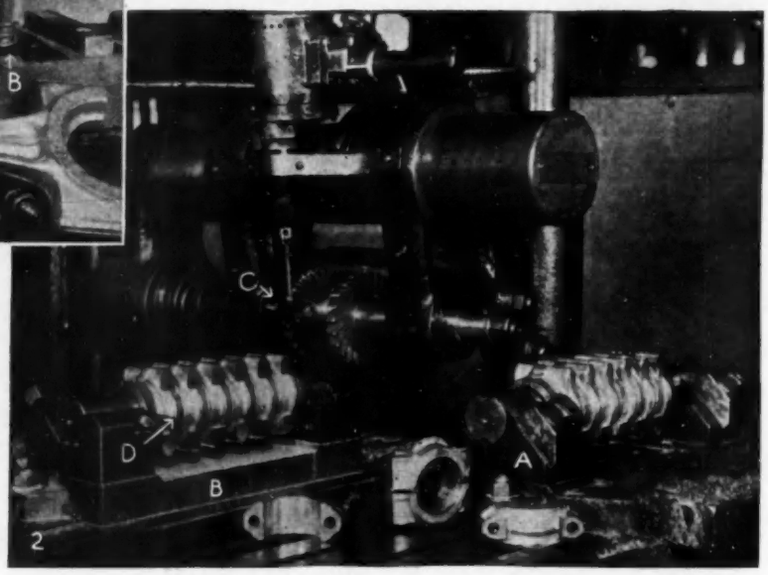


Fig. 2—Drilling both ends of rod in fixture, locating by small end and sides of the bolt bosses. A guide is provided above the large end drill to take care of the side thrust due to the open end of the rod

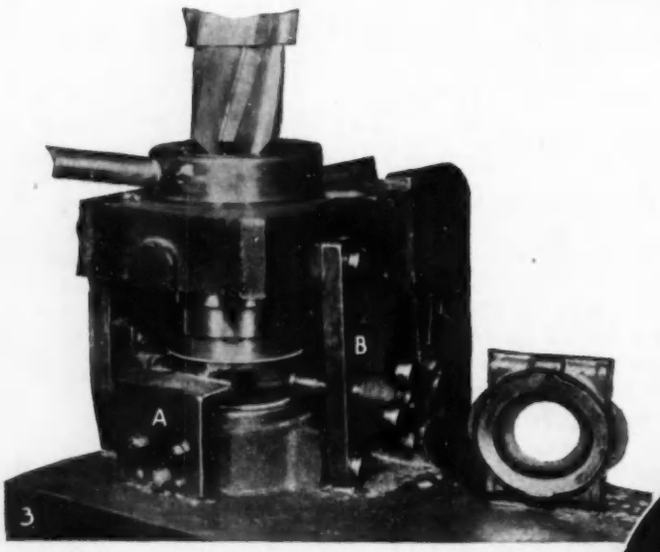


Fig. 3—Fixture for boring the steel forging which makes the caps for two rods. These caps are also located by the sides of bolt holes. The hole is elongated by shifting the eccentric bushing and moving the upper slide of the fixture

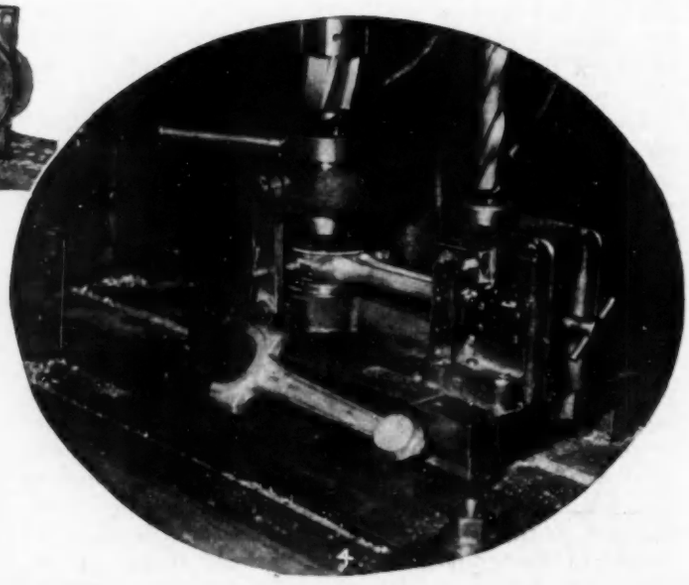


Fig. 4—Bolt bosses on the cap are milled to provide a registration surface that will correspond to that on the rod. After babbitting the caps are placed on a mandrel and clamped endwise. Three cutters are used, two to mill the bosses, and the other to separate the caps. The mandrel has two flat sides for indexing purposes

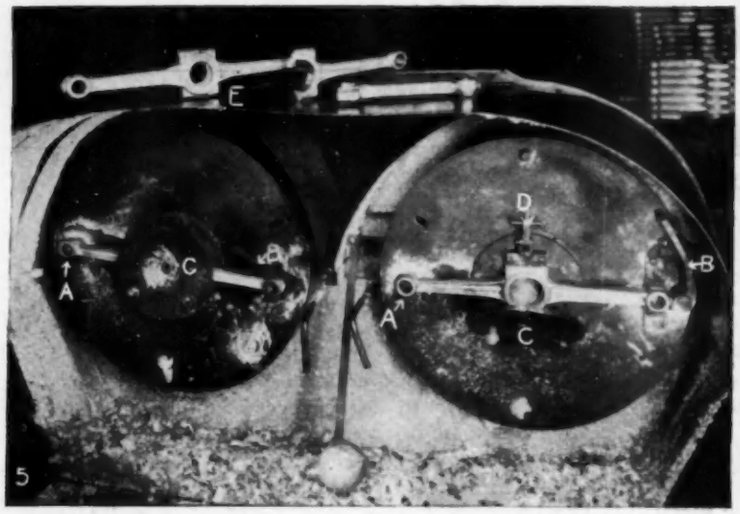


Fig. 5—Babbitting two connecting rods together. The rods are centered by an end stud and two side plates. A cam at the other end is arranged so that the spinning motion keeps it locked.

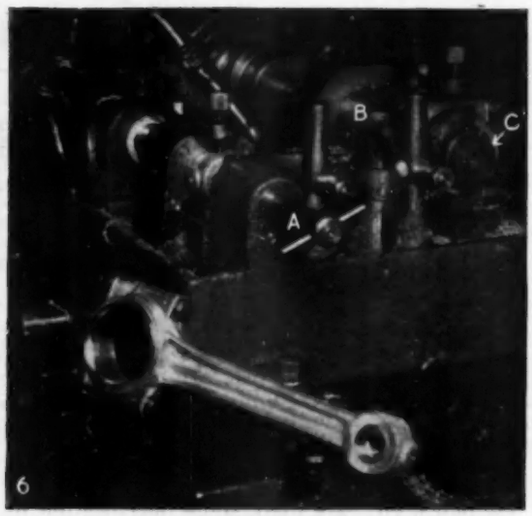


Fig. 6—Special boring fixture mounted on an engine lathe. The small end is located by a standard plug, and the large end is held so as to avoid distortion. The large end is finished with a fly cutter in a large boring bar and after being inspected the piece is sent to stores

shown at the right. Another point of interest is that the cam on the lever *B* is in its locked position when the lever is swung out, so that the centrifugal force imparted by the revolving disk insures its remaining in the locked position during the babbitting operation.

After the rods and caps have both been separated and the mating surfaces suitably faced, the rods and caps are paired and numbered, and both have the bolt holes finish broached at the same time. Cap and rod are then bolted together and are finish bored in the fixture shown at Fig. 6.

This fixture consists primarily of a heavy cast-iron base which carries bearings both for the locating plug *A* and the finish boring bar *B*. The rod is centered on the plug *A* and held by clamping the large end, which is held both sidewise and vertically under light tension. The finishing cut is taken by the fly cutter in the end of the large diameter boring bar at *C*. The fixture is bolted to the top of an engine lathe carriage from which the cross-slide has been removed.

There are, of course, other operations on both rod and cap, such as the drilling of the bolt holes, that have not been described or illustrated. These are what may be called standard practice, while those shown are out of the ordinary. The forged steel cap appreciably stiffens the connecting rod bearing and goes a step farther than the practice of reinforcing an aluminum alloy cap with a steel plate as has been done in some engines.

Inspectors for the Shop—Why Not for the Draftsman?—*Discussion*

By John F. Hardecker
Chief Draftsman, Naval Aircraft Factory

WITHOUT any desire to disagree with J. A. Potter in his comment under the above heading in Vol. 70, No. 22, of the *American Machinist*, I would like to point out that his system of developing draftsmen is not necessarily applicable to all kinds of drafting work. While it may be perfectly feasible in the industry with which he is associated, it would not be at all practical in the aircraft industry, for example. In such an industry, mere "craftsmanship" in drafting developed in a youth who has risen from the ranks via the blueprint room would avail him little when it came to actual design. Such a man would soon strike a "dead end" in his drafting career beyond which it would be impossible for him to go, since he has neither a technical background nor a practical knowledge.

It is far better in such industries to develop draftsmen from engineering college graduates, who are familiar with the rudiments of technical design, or mechanics from the shop, who are familiar with practical shop processes. Then, having mastered the "mechanics" of drafting, they can contribute something worth while.

As to a man checking his own work, I believe this is perfectly feasible in the case of the older and more experienced men. I would term the process rather as issuing drawings without checking, for a man would seldom find a major error in his own work by formally checking it. The real merit of the system, which obviously saves drafting time and costs, lies in the greater concentration applied to his work by a man who knows that he is thus trusted, and that there will be no one to uncover his own carelessness before any damage is done.

The fallacy of complete checking of all drawings lies in the indifferent attitude developed in the draftsman, in that he feels "the checker will catch any mistake—that's what he's there for," and long direct association with the checker takes away any sting to his pride for the error uncovered. It is not fair, nor does it represent a healthy condition when the checker is leaned upon too heavily. Sending out unchecked drawings certainly spurs up the draftsman, and acts as a sort of tonic to him. Obviously, discretion must be exercised in picking out the work, and the man whose work is to go unchecked. When this is done, statistics have shown that charges against the engineering department for errors do not increase.

Aluminum Alloys for Pressure Die Castings

By Sam Tour
Vice-President, Lucius Pitkin, Inc.

IN CONSIDERING the required properties of pressure die-casting alloys from the production, standpoint, let us start with virgin raw metals and follow them through to the finished casting. If iron pots are used for alloying, there will be a certain amount of iron picked up in this operation. If silicon in the form of metallic silicon, nickel as nickel shot, copper as copper clippings, etc., are used, some over-heating of the metal in order to effect good solution is inevitable. Also some oxidation will take place and fluxing and skimming off of dross should be practiced. Fluxes employed on aluminum usually contain zinc chloride or magnesium chloride or both. The alloy must be such that these additions will not be detrimental.

In die-casting machines, iron melting pots and iron pressure retorts are used and there is the inevitable iron pick-up from them. The alloy must be such that it does not too readily attack these machine parts and also such that the iron picked up here will not be detrimental. On the average about 0.5 per cent of iron is picked up here from the time the metal is put in the machine until it is made into a casting. In addition to this iron pick-up, the metal has also taken up an unknown amount of gases and oxides.

Air pressure suddenly applied forces the metal to enter the die, filling the gate, runners, casting cavity, vent and over-flow cavities. The entire operation of filling is accomplished in a fraction of a second, the molten metal traveling at very high velocities through the constricted inlet and through the thin sections of the casting. The venting of the air in the die as the metal rushes in can usually be so arranged as to avoid large air pockets, and inlets can be so distributed as to eliminate swirls to a considerable extent, but even under these improved conditions some alloys will give much better surface finish than others. Where surface finish is of considerable importance, as is often necessary to change from one alloy to another in order to obtain the desired result. Often it is impossible to predict from a study of the casting itself and of the arrangement of the inlets, vents, etc., which alloy will give the best surface appearance. The best alloy must be found by trial.

Erosion of the Dies

The molten metal impinges on various portions of the die, and the metal must be such that it will not unduly attack and erode the die materials. Graphite, oils, clay washes, mica preparations, etc., are used to coat the dies periodically to assist in withstanding this attack. Temperature, both of incoming metal and of the die proper, is of course of fundamental importance. Size of inlets with respect to weight of metal passing is also of importance. In addition, the properties of the alloy are important. Alloys low in iron sometimes will ruin the most expensive die in a few hours, while alloys with iron at 1.5 to 2.0 per cent will give no trouble at all. Some high-silicon alloys seem to have a much greater tendency to attack the dies than other alloys lower in silicon.

The alloy must have sufficient fluidity and range of fluidity and semi-fluidity or plasticity between allowable maximum casting temperature, as limited by its effect on machine parts and die materials, and final solidification to allow of complete filling of the die cavity before it cools. In some aluminum alloys, particularly the copper-aluminum and silicon-aluminum alloys, iron to a limited percentage improves flowing properties, but the higher the copper content, the less is the effect of iron with regard to this property. In the silicon alloys the iron, however, is more apt to act to the detriment of the mechanical properties in the final casting. Sometimes foreign matter, such as dissolved gases, suspended oxides, etc., cuts down fluidity, and a good fluxing with zinc chloride or magnesium chloride is helpful in restoring it.

Shrinkage Effects

When the metal solidifies in the die it does so from the surface inward to the center of the sections as cast, during which the natural solidification shrinkage takes place. The surface is fed from the center of the section and natural solidification shrinkage therefore concentrates in the center of the sections and causes porosity. Feeding by means of risers as in sand-casting or permanent-mold casting practice is impossible. Porosity at least equal to the liquid shrinkage from casting temperature to solidification temperature plus solidification shrinkage must be present in pressure die castings. The alloy, then, should have as small a liquid shrinkage and as small a solidification shrinkage as possible. It is often found that porosity in the center of a perfectly vented section varies with different alloys. Also the higher the casting temperature above the final solidification temperature, the greater is the porosity. Indications are that silicon is an important factor as is also iron, manganese and magnesium. Silicon seems to increase fluidity and decrease shrinkage provided iron is kept to a proper proportion. Iron in amounts increasing from 1.50 to 3.0 per cent in copper-aluminum alloys with copper decreasing from 14 to 4 per cent seems to decrease shrinkage to some extent. Manganese with medium low silicon and low iron seems to be beneficial, whereas with higher silicons it sometimes seems harmful.

After the metal has solidified in the die the properties that are important are coefficient of contraction, hot shortness, ductility and strength of the alloy. By contraction is meant the actual contraction that the alloy

Abstract of a paper delivered at the Annual Meeting, A.S.T.M., held at Atlantic City, N. J., June 24-28.

would have in cooling from the temperature of solidification down to the temperature of removal from the die, if the casting were allowed to cool unrestrained. In pressure die casting the steel dies do not allow for any actual contraction during this period, and therefore the solidified metal must stretch an amount equal to this contraction. The hotter the die and the sooner the casting is removed from the die after solidification, the less stretching will take place.

Zinc in aluminum alloys causes hot shortness. In pressure die casting it must be kept low in proportion to the nature of the casting being made. In some cases as little as 0.25 or 0.5 per cent will ruin the alloy; in other cases as high as 1.25 to 1.50 per cent is permissible. In so far as is known zinc in percentages up to 1.5 per cent is not harmful to the mechanical properties of the finished casting. This amount in copper-aluminum alloys is even beneficial in that it increases strength and machineability at room temperatures.

Nickel in proper percentages is thought by some to increase strength at elevated temperatures, to cut down run marks or flow lines or cold shuts in the finished casting, to cut down the avidity with which the molten metal attacks iron and steel machine and die parts, and to offset to some extent the effects of iron in the alloy. Nickel seems to have the property of increasing the strength and hardness of the finished casting in much the same way as does iron, but without the development of excessive brittleness. Nickel also seems to give improved polishing properties. Nickel does not seem to have the deleterious effects of iron on high-silicon alloys.

Silicon when added to quite a number of aluminum alloys seems to decrease shrinkage and increase ductility at elevated temperatures. An addition of 1 or 2 per cent silicon or a 1 or 2-per cent increase in silicon content of the alloy very often prevents cracked castings in production. Such additions have a tendency to harden the alloys somewhat and should be compensated for by a corresponding reduction in copper or copper and nickel content.

Magnesium Important

Magnesium in amounts of 0.10 per cent seems to decrease fluidity, increase shrinkage, cause some additional hot shortness and decrease strength at elevated temperatures. In some castings its presence must be avoided, in others 0.05 per cent is allowable and in others 0.10 per cent. Magnesium also has a marked effect on the mechanical properties of the finished castings. Initial hardness is increased, some age hardening often results, ductility is greatly decreased.

Tin decreases the strength and ductility of aluminum alloys at elevated temperatures even more than at room temperatures. This can be partially overcome by the liberal addition of silicon to the alloy, the amount of silicon necessary being usually three times the amount of tin added. Tin does, however, improve the machineability of aluminum alloys.

Machineability is often a source of difficulty with aluminum diecastings. They can be too soft and stringy and therefore difficult to machine. They may be too hard and therefore difficult to machine. They may be full of hard spots which quickly take the cutting edge off the tool. By proper grinding of cutting tools the trouble due to the first two sources can be overcome.

There seems to be the general impression that high iron content is the basic cause for all machining troubles. However, practically all alloy additions to aluminum except tin and zinc, and possibly silicon in some instances, increase hardness as it affects machineability.

Often hard spots are accompanied by high iron. If the clean machined surface showing one of the hard spots is treated with a solution of potassium ferricyanide containing a little sodium chloride, a blue scum will quickly form over the hard spot if iron is present. In a vast majority of cases hard spots are not due to high iron, but are simple inclusions of aluminum oxide, dross, or other foreign materials. High iron, however, often accompanies hard spots caused by overheating and long stewing of molten aluminum in an iron pot. By proper fluxing of the metal the hard spots or inclusions can usually be removed and the fluxed metal, although high in iron, will give no trouble due to hard spots.

Machining Qualities

Tin and zinc both increase machineability of aluminum alloys, particularly the former. The addition of only 0.5 per cent of tin is often sufficient to give free machining properties. The advantage gained by additions of tin beyond 2.0 per cent are very slight as regards machining, while the disadvantages as regards casting properties of the alloy become considerable.

Polishing properties are important in many instances. Very soft metal is much more difficult to polish than hard metal. Silicon deadens the luster and decreases reflectivity, as also does tin. Copper, nickel and iron all improve polishing properties, brighten the luster and increase reflectivity. Magnesium seems to be harmful to polishing properties; manganese, beneficial.

Nickel plating of certain aluminum-base die castings has been a quite regular practice for a number of years. More recently cadmium plating for corrosion resistance has become fairly common practice. At present several companies are attempting to chromium plate over copper and nickel with more or less indifferent results. In nickel plating it seems that copper, nickel and iron additions, in the order named, improve plating properties, while silicon, zinc, magnesium and tin are detrimental.

Every time the alloy goes through the process certain impurities are picked up, mainly iron to the extent of 0.5 per cent. The average ratio of weight of finished castings to total weight of metal actually cast is of the order of 1 to 3. This means that the finished catsings are made of metal which has been through the casting machine an average of three times. This means that a total of 1.5 per cent of iron has been picked up. This added to the original 0.5 per cent of iron as an impurity in the metals used, plus the 0.3 per cent picked up in alloying in iron pot furnace practice, means a total average iron content in finished castings of 2.3 per cent.

By use of refractory-lined alloying furnaces, the iron pick-up due to alloying can be eliminated. By careful control of casting temperatures and gating and venting so as to permit of as low casting temperatures as possible, the iron pick-up in the process might be reduced to 0.4 per cent or even as low as 0.3 per cent per operation. By a redesign of casting machines and development of better die steels, gates and runners could be made smaller and shorter and the average ratio of weight of finished castings to weight of metal cast might be brought down to 1 to 2.

IDEAS FROM PRACTICAL MEN

The department, "IDEAS FROM PRACTICAL MEN," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the metal-working industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from a minimum of five dollars upwards, depending upon their merit.

Simple Tools for Babbitting and Boring Connecting Rods

BY EDWARD F. KORNSCHUTZ

The babbitting fixture shown in Fig. 1 is made of machinery steel, is easy to use and turns out a satisfactory job. The mandrel *B* is made of double strength pipe and is a force fit in the base *A*. The cap, *C*, is a free fit on the mandrel *B*, and the bolt *D* holds the assembly in place. Mandrel *B* is tapered $\frac{1}{32}$ in. toward the top end to facilitate its removal, and bolt *E* is used to force off the top after the babbitting is done. If there are no holes in the rod, two may be drilled as shown at *H* and *J*, a $\frac{5}{16}$ in. hole to admit the babbitt and a $\frac{1}{8}$ in. hole for venting purposes.

After pinning the rod and installing the shims between the rod and cap, the assembled base and mandrel *A* and *B* is located by the lugs *X* on the rod. Lugs *Y* and pins *Z*, of the jig hold it central both ways. The cap *C* is then put in place and held by the bolt *D*.

The rod is dipped into a kettle of molten babbitt, being submerged slowly and at an angle, to allow the babbitt to run into the $\frac{5}{16}$ in. hole. Care is necessary not to submerge both holes or an explosion will result from the air pocket. When the metal runs freely from the $\frac{1}{8}$ in. hole and all hubbling has ceased, the rod is ready to come out. By keeping the metal at the proper temperature, this operation takes very little time.

The boring jig, which is located on the face plate of a lathe and secured by suitable cap screws and dowels, is shown at Fig. 2. A counter balance is provided as the machine runs at high speed for this operation. The piston pin end of the rod is located on pin *F*, Fig. 2, and the lugs *X* rest on buttons *G* and against stop *H*. If the rod is bent or twisted, it should be aligned so that the lugs rest on both buttons at the same time. The wedge shaped clamp *I*, holds the rod down on the button *G* and against the stop *H*. Clamp *J* holds the rod firmly in place.

With a substantial boring tool, two cuts will finish the job. The thrust flanges and the fillets are cast to size and require no machining. By substituting a suitable angle plate in place of the tool post on the lathe, a portable electric drill may be used to cut the oil grooves in the bearing. A Woodruff key cutter or other suitable tool may be used for this purpose.

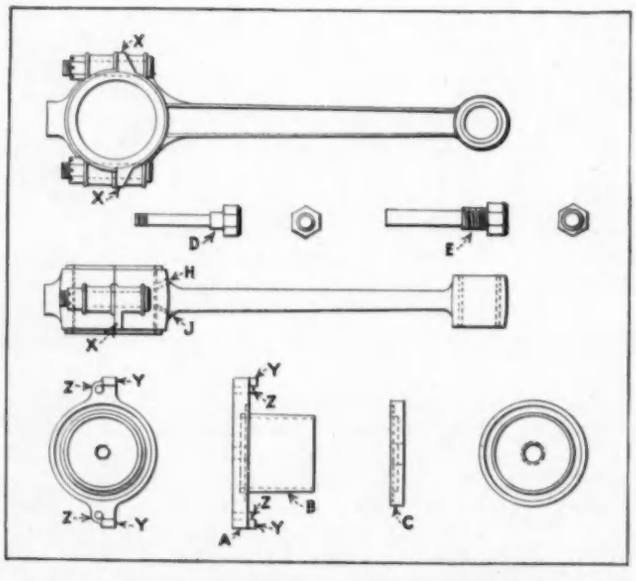


Fig. 1—Connecting rod and the fixture for babbitting it

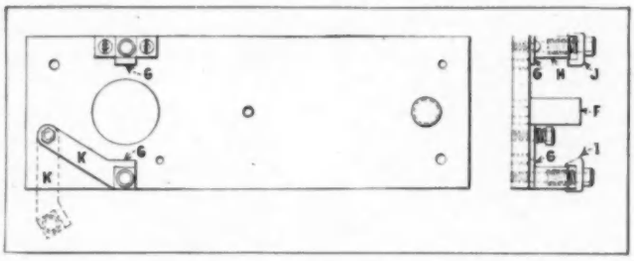


Fig. 2—Fixture for boring connecting rod bearings

The coil springs under the clamps *I* and *J* raise the clamps clear of the work, when loading or unloading. The cap screw holding the clamp *I* should not enter more than three or four threads as it is screwed out all the way to allow the arm *K* to swing clear of the work.

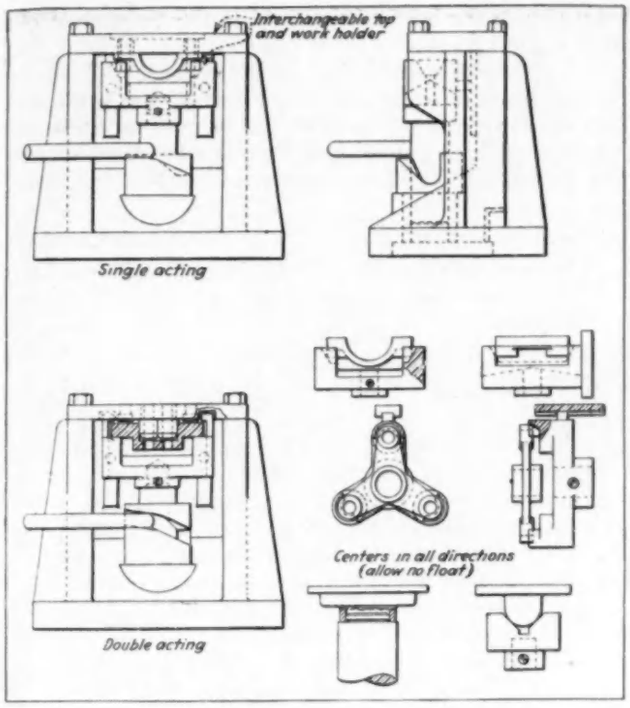
To separate the cap from the rod, the bolts are loosened and the rod placed on a mandrel in the vise. A slight pressure on the end of the rod will easily break the fin of babbit between the bore and the shims. This method may be applied to other rods as well as the Yellow Knight rod shown.

Quick-Lift Cams for Jigs and Fixtures

BY GEORGE H. FELTNER

Two jigs provided with quick-acting cams for clamping and releasing the work, are shown in the illustration. The jig in the upper left-hand corner has a single acting cam. Cams of this type are used where the weight of the clamping device is sufficient to allow it to drop as the lever is moved toward the low point of the cam.

In cases where the drop, or opening movement, of the holding device must be positive, it is advisable to use cams of the double-acting type, such as the one shown in the jig in the lower left-hand corner. In the lower



Jigs fitted with quick-acting cams

right-hand corner are shown some work-holding devices applicable to jigs of the type illustrated.

The cams and the plungers are assembled as a unit, and are applied to the jigs by pressing the cam member into a hole in the base.

While the jigs shown are made of cast iron, cams and plungers can readily be incorporated in jigs and fixtures of the welded type by welding pads on the bases and boring them to receive the cam members.

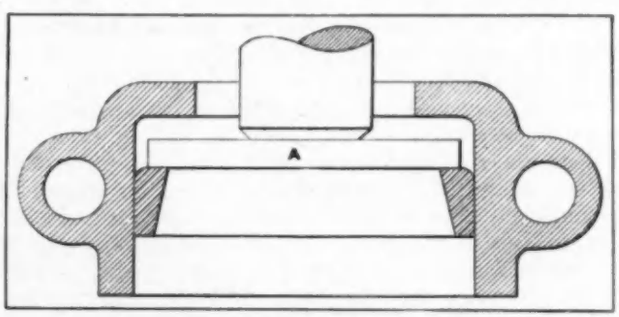
A Kink in Fitting Roller Bearings

By Donald A. Hampson

The drawing shows a cross-section of a cast-iron box in which the cup of a roller bearing is part way in the depth of the bore. The box is of typical design, having one partly blind end and one end to be closed by a cap. In a certain shop, bearings such as the one shown were made in sets of four, of a size for 2-in. shafts. The work presented all the problems that appear in shops where roller bearings are installed occasionally—not as a manufacturing proposition. The chief problem was to make a fit that would be tight enough to prevent the cone from turning in the box, but not so tight as to cause distortion or to stress the box unduly.

Calipers and inside micrometers were used to check the bores, but the "feel" of these tools and the amount of swing to give one end are uncertain factors. Workmen like to apply the acid test of fitting the cups right in the bores, as a means of checking their measurements and of finding out how much the bores are tapering.

In the shop referred to, the kink shown in the illustration was made use of. The trial of the fit was made after the boxes had been taken out of the chuck, having been bored to close dimensions, as near as could be measured. A piece of drawn steel, *A*, about 2 in. wide and a little shorter than the diameter of the bore, was put in the box before the cup was tapped down in the bore. With the piece of steel in place, the cup could be forced out at any time by direct pressure from an arbor press. If the fit was found to be too tight, the bore was scraped out where it showed black, without anything more accurate than a casual rechucking in the lathe.



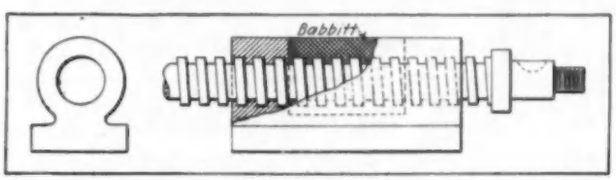
Box with cup of roller bearing partly seated and removing piece in position

An Emergency Repair

By C. L. Nadon
Superintendent, Globe Electric Company

The threads in the nut in the cross-slide of one of our surface grinders were stripped and the screw was badly worn in spots. We ordered a new nut and a new screw, but found that it would take from ten days to two weeks to get delivery. Since we could not afford to have the machine out of commission more than five hours, we decided to make temporary repairs.

The nut was cut away as shown by the dotted lines in the sketch. The screw was placed in the nut so that the least-worn part came in the opening, and a shield of tin



Nut cut away for casting babbitt around the screw

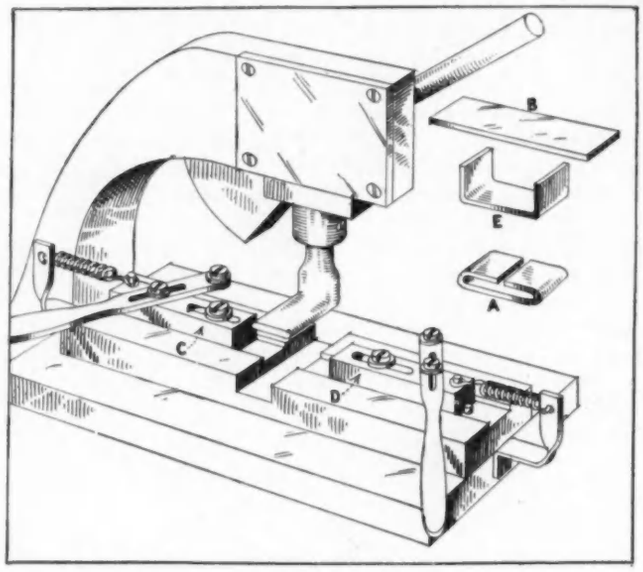
plate was fitted to the nut so as to close the opening. A hole was made in the top of the shield and served as a gate. With all parts in place, they were heated and the opening in the nut was then filled with hard babbitt, pouring it in at the gate at the top of the shield. In less than an hour and a half, the machine was back in service with the worn parts repaired so that they would last until the new parts arrived.

Bending Small Parts in a Hand Press

By Charles H. Willey
Asst. Plant Supt., Hoyt Electrical Works

In bending small parts, one of which is shown at *A*, we recently made a change in the method of doing the work. Bending was formerly done in power presses in two operations. It is now done in the hand press shown in the illustration.

The blank *B*, of 0.010-in. semi-hard brass, is placed in the die between the slides *C* and *D*, and is bent by the punch into the shape shown at *E*. With the punch



Hand press and tools for bending small parts

at rest in its lowest position, the slides are brought towards each other by hand levers, bending the vertical sides of the piece and folding them over the toe of the punch. When the levers are released, the slides are brought back to their starting positions by springs.

When the work was done in two operations in power presses, the cost was seven cents per hundred for each operation, making a total cost of fourteen cents per hundred, exclusive of the cost for power and for insurance under the workmen's compensation act. The work is now done by a girl operator in the hand press shown in the illustration, the production being 600 per hour at a price of eight cents per hundred. As the press is operated by hand there is no cost for power, and the danger of injury to the operator is greatly lessened.

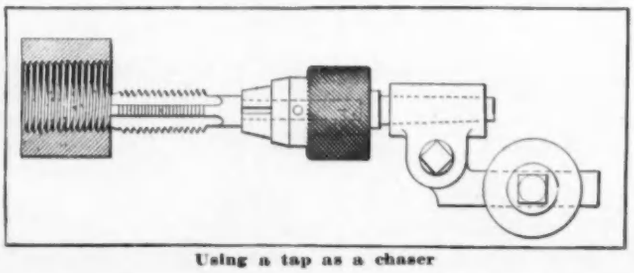
Cutting Internal Threads in Tough Metals

By Arthur F. Parker

In experimental work it is often necessary to cut internal threads in copper, nickel or other tough metals, and it is almost impossible to produce smooth work with a single-pointed tool. In the illustration (which is a plan view) is shown a quick and easy method of doing such work satisfactorily.

The cutting is done by a tap of the desired pitch, but smaller in diameter than the hole in which the threads are to be cut. With the work mounted in the lathe chuck in the usual manner, the tap is held in a drill chuck, the straight arbor of which is clamped in a holder for small boring tools, the holder being held in the toolpost of the lathe.

It will be understood that the cutting edge of one of the tap lands is set at the center line of the work and that the tap does not revolve, but is used as a chaser. Taps on which the first few threads have been broken may be ground to suitable shape and kept for such work.



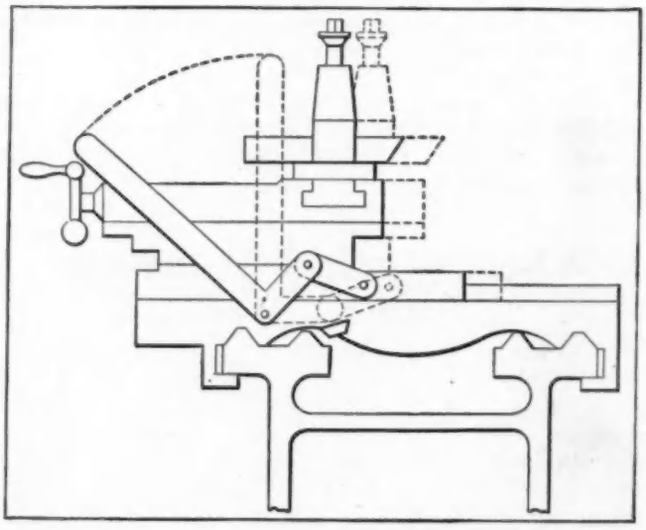
Using a tap as a chaser

Device for Controlling Movements of Threading Tools

By E. H. Fader

We make large quantities of worms that are integral with their shafts. The blanks are steel forgings, and their size and shape are such that our thread milling machine can not be used for the job. So the threads are cut in a heavy-duty lathe. The worms are $7\frac{1}{2}$ in. in diameter, $8\frac{1}{4}$ in. long and have a lead of $1\frac{5}{8}$ in. Since the full depth of the thread is about one inch, backing out the tool after the completion of a cut and feeding it in for the next cut, using the cross-feed screw, takes about one-fourth of the cutting time.

In an effort to save labor and expedite the work, the operator worked out the quick-acting device shown in the illustration. The device consists of a lever in the shape of a bell crank, pivoted to the carriage bridge; a link, one end of which is pivoted to the lever and the other end to the toolblock; and a permanent stop on the carriage bridge, so located that when the toe of the lever contacts with it, the joint of the link and lever falls below the center line of their attaching studs, as shown by the dotted lines. Thus, any force tending to move the toolblock toward the front of the carriage is defeated by causing the lever to bear harder against the stop.



Quick-acting device for use in cutting threads

With the cross-feed screw out of commission, the toolblock is moved in or out by pushing or pulling the lever, feeding the tool in or withdrawing it, as the case may be. The pressure of the cut can not force the tool away from the work, because the toolblock is locked by the position of the lever and the link when the lever is against the stop. The depth of each cut is controlled by the screw of the compound rest.

Design of Shafts for Strength

Uniform Circular Cross-Section

Allowable working stresses for various kinds of service are necessarily matters of judgment and experience with each particular type of service. The following formulas and stresses are those used in the practice of the author.

Allowable bending moment $M = 0.0982\ d^3S$, where d = shaft diameter, and S = allowable bending stress

Allowable turning moment $T = 0.19635\ d^3S_s$ where S_s = allowable shearing stress.

Therefore, $d = \sqrt[3]{\frac{M}{0.0982\ S}}$ or $d = \sqrt[3]{\frac{T}{0.1963\ S_s}}$

when only bending or torsional moment is acting.

When both are acting:

Equivalent bending moment $M_e = \frac{1}{2}\ [M + \sqrt{M^2 + T^2}]$

Equivalent turning moment $T_e = \sqrt{M^2 + T^2}$

The allowable working stresses, in the following table, which are based on the elastic limit include a factor of safety of 2½, while those based on the fatigue limit include a factor of safety of 2. These values are for shafts subject to variable but not reversed loads. For reversed loads the values given should be halved.

In detailing shafts and axles it has become common practice, when shafts are to be heat-treated, to specify the Brinell hardness range desired. The values in the table, therefore, are based on the Brinell hardness specified in each case. In order to be on the safe side, the Brinell hardness specified is taken at the low end of the carbon range.

Where several steels are included under one classification, the values in the table are taken for the steel having the lowest physical property. The elastic limit in each case is taken at the yield point. Variations in strength due to slight changes in composition are small when compared with the factor of safety included in the values given in table. For cases where the Brinell hardness varies considerably from that selected in the table, the values for allowable stress may be easily determined, as the allowable stress varies directly as the Brinell hardness.

SERVICE AND MATERIALS	Allowable Tension Stresses		Allowable Torsion Stresses	
	Based on Elastic Limit	Based on Fatigue Limit	Based on Elastic Limit	Based on Fatigue Limit
Light Loads, Slow Speeds				
Carbon steels as rolled				
S.A.E. 1035 (149 Brinell)	20,000	20,000	14,000	12,500
S.A.E. 1045 (171 Brinell)	22,800	21,375	16,000	14,400
S.A.E. 1050 (183 Brinell)	24,000	22,800	16,800	16,000
Medium Loads, Medium Speeds				
Carbon steels heat-treated for toughness				
S.A.E. 1035, 1045, 1050 (224 Brinell)	29,000	27,400	20,000	18,500
Light Loads, Medium Speeds				
Case hardened for surface hardness				
S.A.E. 1020 (core 183 Brinell)	21,600	23,100	15,100	14,700
Medium Loads, Medium Speeds				
Alloy steels heat-treated so as to be straightened and machined after treatment				
S.A.E. 3130, 3140, 3235, 3240, 3250 (235 Brinell)	40,000	27,500	28,500	22,000
S.A.E. 4130, 4140, 4150 (331 Brinell)	58,700	42,250	35,200	27,400
Medium Loads, Medium Speeds				
Alloy steels, case hardened for surface hardness. Can be straightened after heat-treatment				
S.A.E. 2315, 2512, 3115, 3215, 4615 (core 311 Brinell)	46,000	37,000	32,500	28,300
S.A.E. 6120 (core 277 Brinell)	44,800	36,000	27,000	26,000
Heavy Loads, High Speeds				
Alloy steels heat-treated for toughness				
S.A.E. 2330, 2335, 2340 S.A.E. 3130, 3135, 3140 S.A.E. 3330, 3335, 3340 S.A.E. 3435, 3445, 3450 S.A.E. 6130, 6140, 6145 (311 Brinell)	50,800	35,000	37,500	29,000

Contributed by G. W. Drake, Advance Designer, the Warner & Swasey Company.

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American Machinist

Editors: KENNETH H. CONDIT AND FRED H. COLVIN

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Beginning Volume 71

WITH this issue the American Machinist enters its seventy-first volume, fifty-two years after its start in 1877. During that period the paper has been edited, successively, by Jackson Bailey, Frank F. Hemenway, Fred J. Miller, Frederick A. Halsey, L. P. Alford, John H. Van Deventer, Ethan Viall, and the present editors.

The present editorial staff includes Kenneth H. Condit and Fred H. Colvin, editors, and George S. Brady, S. Ashton Hand, Frank J. Oliver, Jr., H. R. LeGrand, William H. Shipman, Chester B. Lord, and George E. Hagemann.

*

Welcoming the Opportunity for Improving Machine Design

SOME of the engineers and production men who are experimenting with the new cutting alloys are so impressed with the results obtained that they foresee far greater production than we have hitherto thought possible. Tool life record ratios of a thousand to one over previous results cannot be brushed aside as a passing fancy. And when we learn what can be done in machines designed to utilize the full value of the new tools, we may find that machining time can be reduced far below present practice.

We are not likely to discover the maximum performance of these new tools by testing them in present machines. For, assuming that we now have very high speeds on some machines, it is probable that other factors affect the results seriously. It is believed that much more rigid machines are necessary to secure the best results; that spindles and work holding devices must be heavy enough and stiff enough to resist appreciable deflection; that tool holders must not permit even a small part of the vibration that now exists in many machines. Tools must be supported with a minimum of joints, perhaps with no joints as we now know them. For, while vibration of the cutting edge has long been recognized as having a direct bearing on tool life, it is doubly important in using the harder cutting materials of the present day.

The outlook is distinctly encouraging from every point of view. Even if it means scrapping large quantities of machinery that we have considered as being modern, it will result in huge re-equipment programs, in substantial reductions in machining costs, with the attendant widening of the market for the product, and the firm intrenchment against competition from those without modern equipment.

We should not lament the necessity for redesigning our equipment but rather welcome the opportunity to so improve it that it will continue to serve industry in producing more economically the necessities and luxuries of our civilization.

*

Selling the Machine Tool Industry to Students

AFTER many years in the shadow of an inferiority complex in which the machine shop was known for its dirt and grease rather than for its product, the machine tool section of the industry is beginning to realize its importance and to make a bid for its place in the sun. A recent booklet issued by the Cincinnati Milling Machine Company gives an outline of some of the problems facing the graduate engineer in the choice of a career, points out the importance of the machine tool industry and its opportunities, and shows how both the industry and the right kind of college men will benefit by their entering the field in which the Master Tools of Industry are produced.

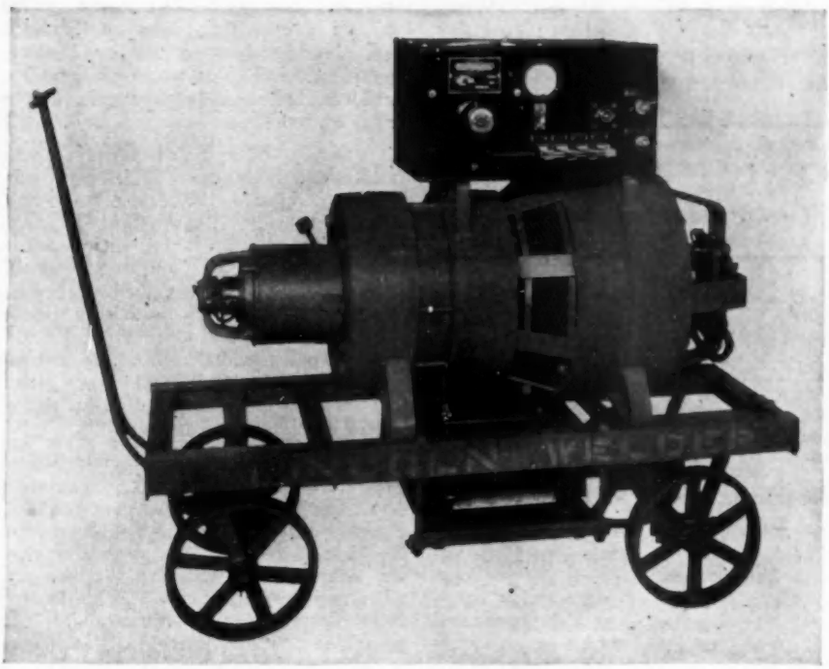
The booklet points out that civilization's advance comes through the dual path of work and dreams. It quotes Dean Kimball as to the romance of building the machine tools that make possible the production of all our mechanical aids to progress and outlines the opportunities that the industry presents in making these dreams come true.

The *American Machinist* has frequently pointed out the dependence of all industries on the continued improvement and development of machine tools. In order to render the best service the machine tool industry must constantly add to its personnel the best mechanical minds available. Many of these men can be developed for the industry from the graduates of engineering schools. It should be in position to pay salaries that will hold them after they are developed. The motive and method of this booklet are to be commended.

MATERIALS · PARTS · AND · EQUIPMENT

Improved Lincoln "Stable-Arc" Welder

FEATURES of design and construction increasing the "Stable Arc" features are introduced in the improved type of welders placed on the market by the Lincoln Electric Company, Cleveland, Ohio. Motor and generator control have been unified. The working mechanism of all controls is contained in a ventilated, inclosed steel cabinet, with hand regulators and switches mounted on a panel forming a side of the cabinet. The control panel contains a rheostat regulator, diverter switch, safety-starter switch, volt-ammeter and wing nut terminals for cables. The control cabinet is mounted directly over the motor generator, giving easy access and simplifying control. The motor-generator armature can be removed without disturbing any other parts.



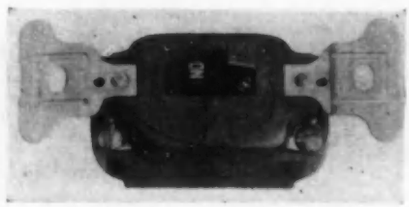
Lincoln Improved "Stable-Arc" Welder

The use of a combined voltmeter and ammeter makes possible the reading of voltage and amperage on one dial and eliminates the use of the separate delicate ammeter. The face of the volt-ammeter is mounted flush with the control panel, for protection. Wing-nut terminals for the lead cables make quick and easy connections possible, especially to reverse the polarity of welding current. These terminals also eliminate the necessity of a switch for reversing polarity. The Lincoln safety push button switch, incorporated in the control panel for starting and stopping the welder, makes it impossible to start the equipment accidentally.

The unified control cabinet incloses the wiring of all operating controls, and the mounting of this cabinet over the motor-generator permits the use of a shorter chassis frame or base than used in previous models. Thus less floor space is occupied by the welder.

Cutler-Hammer Rubber-Mounted Toggle Switch

A rubber-mounted toggle-type switch intended especially for quiet operation has been announced by Cutler-Hammer, Inc., 80 12th St., Milwaukee, Wis. The mechanism is mounted directly upon two soft rubber pads. Other features are dust-proof construction, long life, non-stubbing contacts, compression-type lubricated spring, and "Thermoplax" cold-molded insulating material for the body and the base. As soon as the lever is moved the quick-acting mechanism gives instantaneous contact.



Cutler-Hammer Catalog 7281 Single-Pole, Rubber-Mounted Toggle Switch

This switch is made in single- and double-pole, three- and four-way types, furnished with either black or brown operating levers and with standard mounting throughout.

Brisben Combination Toolholder

The adjustable combination toolholder shown in the illustration is manufactured by Ernest J. Brisben, 14203 Orinoco Ave., Cleveland, Ohio.

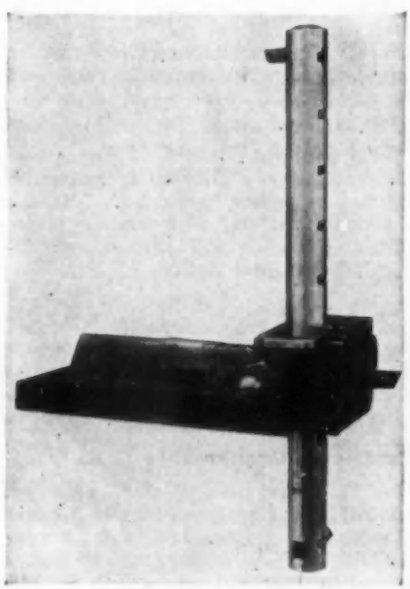


Fig. 2—Brisben Adjustable Combination Toolholder arranged for facing and recessing

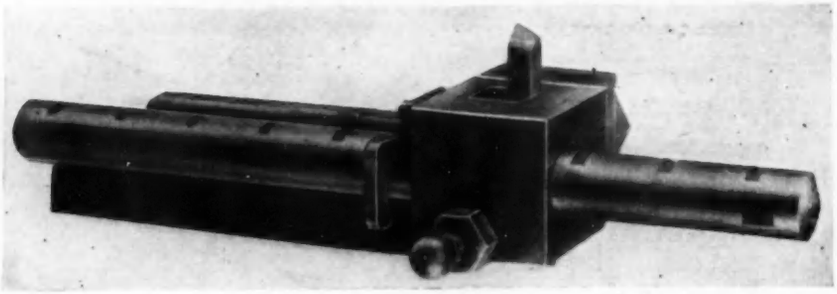


Fig. 1—Brisben Ajustable Combination Toolholder set for boring

The tool may be set for boring on a lathe or cutting a keyway on a shaper. By turning the rectangular head 90 deg., the tool can be used for recessing or facing. The notches in the bar permit it to be set to any desired length within its capacity. It is claimed that for some varieties of work it gives an ordinary lathe some of the advantages of a turret lathe. A draw-in taper key controlled by the round knob, locks the rectangular head from either turning or sagging. The device uses standard toolbits.

REVIEW OF RECENT PATENTS

Relating to the Machinery and Metal Products Industries

Metal-Working Machinery

A machine for generating gear wheels patented, 1,712,254, and assigned to the Barber-Colman Co., has a combination of a frustrated-cone grinding wheel having a number of plane grinding surfaces, and a means for rolling a toothed blank across the periphery of the wheel. A separate patent, 1,712,255, covers the grinding wheel.

Patent 1,712,256 was assigned to the Barber-Coleman Co., and covers a gear-cutting machine in which the cutter is at least equal in circumference to the pitch circle of the gear wheel to be formed. The machine has a tool support mounted on a reciprocating ram, and the work supports travel past the cutter at slow speed.

The Hollow Ball Co., Inc., was assigned patent 1,712,446 on a machine for making hollow metal balls. It has a hopper feed and two rotating plates with co-operating ball grooves for rolling and sizing the balls.

The Monroe Calculating Machine Co., Inc., was assigned patent 1,713,690 on a spring testing machine in which the coil springs are fed on fingers and compared automatically with a pre-determined standard.

Parts and Mechanisms

A lubricant compressor patented, 1,711,777, and assigned to the Alemite Manufacturing Corporation, has a nozzle with a concave metallic part with a leather sealing washer to form a tight seal, and a cylinder containing a compressing piston with a pistol grip. Another patent, 1,711,903, assigned to the same company, covers a grease gun having a discharge tube sliding in the barrel and a hollow piston in the barrel.

The Landis Tool was assigned patent 1,712,314 on a work rest for grinding machines, which comprises a fixed jaw a pivoted jaw in an adjustable frame carried by a stationary frame.

Materials

A forging alloy steel was patented, 1,711,519, by John L. Cox, of Philadelphia, Pa. It contains 4 to 20 per cent of chromium, 6 to 18 per cent of tungsten, 1 to 6 per cent of aluminum, and 0.35 to 1.5 per cent of carbon.

A process for putting a protection coating on iron by diffusion was patented, 1,711,603, by Emil Lay, of Frankfort-on-Main, Germany. It consists in heating the iron with a powder containing from 8 to 30 per cent of free metallic aluminum.

A chromium-manganese-tungsten alloy steel was patented, 1,711,733, and assigned to Fried. Krupp, A. G., Essen, Germany. It contains from 8 to 18 per cent of chromium, 2 to 12 per cent of manganese, 3 to 12 per cent of tungsten, and up to 1 per cent of carbon.

Patent 1,711,807 was issued to Laurence R. Preston, of Devonport, England, on a solder for aluminum alloys. It contains tin, zinc, aluminum and bismuth, and is coated with stearic acid, silver sand, and phosphor tin.

An acid-resistant steel patented, 1,712,030, and assigned to the Ludlum Steel Co. contains from 14 to 30 per cent of nickel, 6 to 20 per cent of chromium, 1 to 3 per cent of silicon, 1 to 3 per cent of tantalum, and up to 1 per cent of carbon, with the balance iron.

Patent 1,713,514 was issued to Rudolf Affel, Berlin, Germany, on a chromium plating solution containing up to 0.5 gram of sodium iodate per liter of chromic acid solution.

TRADE PUBLICATIONS

GEARS, "FABROIL." The Chicago Rawhide Manufacturing Co., 1301 Elston Ave., Chicago, Ill., has issued a price list and engineering data on "Fabroil Gears," a development of the General Electric Co. Tables of dimensions are included. The catalog contains eleven 8x10½-in. pages.

LATHES. The South Bend Lathe Works, 426 E. Madison St., South Bend, Ind., has published Catalog No. 90-A, which contains illustrations, descriptions, and prices of the entire South Bend line of lathes from the 9 to the 18-in. sizes, inclusive. Several new model lathes are added with this edition of the catalog, and several new lathe attachments are also offered. Complete specifications for each product are given. The bulletin contains 95, 9x6-in. pages. It is well illustrated throughout.

PUNCH PRESS FEEDS. The F. J. Littell Machine Co., 4125 Ravenswood Ave., Chicago, Ill., shows in its "Punch Press Feeds," Vol. 1, No. 8, a new No. 1 roll feed, a No. 4 dial feed, a ball bearing reel with arms, and a reel with band around arms. Each item is fully described and illustrated. The pamphlet contains four 11x8½-in. pages.

WELDERS, SPOT. The Acme Electric Welder Co., Huntington Park, Los Angeles County, Calif., has published five folders showing the sizes of "Hot-Spot" welders manufactured. The first shows Groups 100, 200 and 250, the second Groups 300, 350, 400 and 450, the third Group 500, the fourth Group 600, and the fifth Group 700 welders, respectively. Each folder gives specifications and photographs of the complete machine and the important assemblies. Each folder is printed on four 11x8½-in. pages.

WESTINGHOUSE PUBLICATIONS. The Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., has published several bulletins as follows: Folder 5181 on steel switchboards, giving installation views of various types; Folder 5179 on steel panels for switchboards, and Leaflet 20,388 describing the Class 12-700 Type A reversing-drum controllers for wound-rotor induction motors. Each folder consists of four 11x8½-in. pages.

NEWS
OF THE WEEK

Westinghouse Engineer Heads A.S.T.M.

Society approves creation of a new general committee to expedite the adoption of material standards

AT THE thirty-second annual meeting of the American Society for Testing Materials held at Atlantic City June 24 to 28, T. D. Lynch, consulting metallurgical engineer, Westinghouse Electric and Manufacturing Co., was chosen president for the year 1929-30. F. O. Clements, technical director, Research Laboratories, General Motors Corporation, was made vice president. C. L. Warwick was re-elected as secretary-treasurer. The new members of the executive committee chosen are: G. B. Haven, professor of machine design, Massachusetts Institute of Technology; C. R. Hook, vice president and general manager of the American Rolling Mills Co., H. E. Smith, engineer of materials, New York Central Railroad, and G. E. Warren, assistant general manager, Portland Cement Association.

59 PAPERS PRESENTED

More than 1,000 engineers, scientists and representatives of engineering colleges from all parts of the country were registered at the conventon. Fifty-nine papers were presented at the meetings, and new standards for engineering materials were discussed. The annual report presented by the executive committee showed that the society has a present membership of 4,244, which includes 1,153 companies, industrial firms, and commercial testing laboratories.

In the president's annual address on Wednesday evening, G. W. Thompson, retiring president, called attention to the fact that the American Society for Testing Materials is one of the oldest standardizing bodies in the country, and that while its name indicates interest in material testing the society has been recognized as an authority in the preparation of standard specifications for materials which will meet standardized tests. He also stated that the Society is composed of representatives of both producers and consumers, not dominated by either party, and that the aim is to arrive at standards that are not mere compromises, but rather those that will serve industry effectively and economically.

A report was made to the meeting showing that a study of the Society's standardization procedure from the point of view of accelerating it in desirable ways has shown rather clearly that there is one step in the procedure that can be expedited without sacrifice of any basic principle underlying the standardization work, namely, the acceptance of proposed new standards as tentative after they have been finally approved by a standing committee. There is often a "time lag" of considerable proportions between final action by a standing committee (which is sometimes taken and often can be taken six or more months before an annual meeting) and acceptance as tentative at the annual meeting—a delay that seems unnecessary and is likely to become a handicap to the Society in serving the standardization needs of industry. It is believed that this time interval can be greatly reduced without jeopardizing the safeguards that the procedure has placed around the establishment of an A.S.T.M. Standard.

The procedure now proposed provides for a review of proposed new standards or proposed amendments of existing tentative standards by a new Committee on Standards, which must determine whether all requirements relating to the preparation and submission of new standards have been complied with and whether the standing committee has reached a substantial concensus in its recommendations. In this it is performing essentially the functions of a session of the annual meeting, with perhaps the added advantage of opportunity for more careful scrutiny of procedure and consideration of the merits of any moot points; it represents, in effect, the interest of the Society as a body in assuring itself of justification for publication as tentative of a new specification.

Committees on various materials have been functioning throughout the year, and among the reports submitted of interest to the metal-working industries were those on wrought iron, steel, ferro-alloys, iron-chromium-nickel alloys, light alloys, non-ferrous alloys, and corrosion and fatigue of metals. Most of these were reports of progress made in testing during the year, and indicated that the importance of gathering test data for the proper selection of engineering materials is becoming more and more apparent. In a report made by the committee on the correlation of research it was pointed out that the Society now has a wide program of projects listed for research bearing on the influence of forging, heat-treating, and manufacturing operations on various metals and alloys.

In a symposium on the physical properties of cast iron held Tuesday evening twelve papers were presented. J. W. Bolton, chief metallurgist of the Lunkenheimer Co. in a paper on the "Classification of Gray Iron Alloys," pointed out the five factors which influence the properties of gray iron castings and advocated a primary classification based on chemical analysis, and a secondary classification based on the cooling rate. Other speakers brought out the great value to the machinery designer of the new so-called high-test cast irons. The influence of alloying elements, such as nickel and chromium on cast iron was also discussed. Impact and wear testing of cast iron, and the corrosion of cast iron were treated in three separate papers.

The Charles B. Dudley medal was awarded to J. J. Kanter, testing engineer of the Crane Co. and L. W. Spring, metallurgist of the same company. This medal is given annually to the author, or authors of the best papers of the year.

* * * *

100-Mile an Hour Speed Limit Predicted at S.A.E. Summer Meeting

SARANAC INN, N. Y., was the scene of the S.A.E. summer meeting and the attendance was even larger than usual, filling the hotel and cottages. Committee meetings considered membership, research, and other subjects. The business session discussed the constitutional amendments, after which Paul G. Hoffman, vice-president of Studebaker sales, spoke on "What I Think Engineers are Good for—and How." He emphasized the necessity of co-operation between engineering and other departments, especially sales and stressed the fact that a device must not only be good but must also appeal to the buying public to be successful. He spoke of the advancing speed-rates on highways, and predicted that we should see superhighways,

with no cross roads, on which 100 miles an hour would be possible and permissible.

Other sessions brought out extensive discussion on technical details. W. A. Whatmough, a consulting engineer of England, presented a very interesting paper on "Combustion Chamber Design" which was discussed by R. N. Janeway, Alex Taub, and others. Motor-truck design received consideration in a paper calling attention to the use of trucks for other than transportation purposes, such as in telegraph- and telephone-line work, and trailer operation was also discussed.

The chassis conference included reports on headlights, riding qualities, front-wheel alignment, and the relation of riding qualities to angular acceleration. Other sessions dealt with transportation, including a comprehensive paper on overland bus service, by R. E. Plimpton, and the way in which the science of business can be applied to motor-truck operation, by N. Mallouf. Mixture distribution called out a wide and animated discussion, while the research session included fuel research, volatility of gasoline and blended fuels, horsepower correction and engine acceleration tests.

The striking feature of the meeting was the talk by John Bellamy Taylor, of the General Electric Co., in which he exhibited and demonstrated devices for making light audible, or, in other words, of transmitting sound by light waves. Mr. Taylor combines scientific knowledge and a personality that carries his audience with him, even in technical explanation, and so makes a remarkable technical achievement not only instructive but also entertaining.

Sport contests and a program of entertainments featured the convention. An amphibian plane and a flying boat carried passengers on flights over the surrounding country.

* * *

First Metals Congress Scheduled this Fall

The first annual Metals Congress, at which leaders in the metals industries and research men from the entire country are expected to be present, will be held in Cleveland, Ohio, from September 9 to 13, according to the preliminary announcements. The congress will be held at the same time as the eleventh annual convention and exposition of the American Society for Heat Treating, of which it is, to a considerable extent, the outgrowth. The annual fall meeting of the American Welding Society, the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers, the Iron and Steel Division of the A.S.M.E., and the Iron and Steel Division of the American Institute of Mining and Metallurgical Engineers are also scheduled to meet at that time in the same city, and to co-operate in the congress.

In addition to the congress, the eleventh annual metals exposition will be assembled in the public auditorium, in which will be displayed and demonstrated modern types of metal-working machinery and equipment. Already over 200 exhibitors have signified their intention of having displays.

Details of the programs are being worked out by W. H. Eisenman, manager of the Congress, who is also secretary of the American Society for Steel Treating. Further information may be obtained by addressing him at 7016 Euclid Ave., Cleveland.

* * *

Leaders of Industry Plan Conference

Over six hundred leaders of industry are expected at the twelfth annual conference on Human Relations in Industry sponsored by the industrial department of the National Council of the Young Men's Christian Associations, to be held at Silver Bay on Lake George, N. Y., from Aug. 28 to Sept. 1. There will be seven sectional conferences on: Scientific approaches to industrial relations, cultivating pride in craftsmanship, value and limitation of employment tests, technique of conducting conferences in industry, industrial relations in other countries, personnel problems on railroads, and industrial and state pension provisions.

Preceding the conference will be three courses on industrial leadership beginning Aug. 20. Course 1 is intended primarily for first-year men at Silver Bay and for foremen, and will have as a leader Harry N. Clarke, counsel on industrial morale of Cleveland, Ohio. Course 2 is primarily for executives and will be conducted by Walter S. Berry, director of training, Scovill Manufacturing Co., Waterbury, Conn. The third course is an advanced seminar limited to men having had five years' experience in foreman leadership. This course will have a different leader each day. A report of discussions and findings will be furnished men in all three courses. In addition, there will be special talks at the first period in the morning in the combined courses on essentials in right industrial relations.

Further details concerning the conference and courses may be obtained from the executive secretary, Fred H. Ringe, Jr., 347 Madison Ave., New York City.

* * *

Curtiss Wright Merger Joins Ten Companies

Ten important aircraft concerns, forming the Keys-Curtiss and Hoyt-Wright groups, will be controlled by the formation of the Curtiss-Wright Corporation, a holding company. This company will have assets of $70,000,000 and will be the largest aeronautical organization in the world. Its formation was announced by C. M. Keys, president of the Curtiss Aeroplane and Motor Co., and Richard F. Hoyt, chairman of the board of the Wright Aeronautical Corporation.

The consolidation, if ratified by stockholders, will comprise a complete line of aircraft equipment. Planes manufactured will range from Moths to Curtiss Condors. The company will also be the largest producer of plane motors, and its products will range from the Wright Gypsy engine, of 80 hp., to the Curtiss Conqueror, of 600 hp., comprising water-cooled, radial air-cooled, in-line air-cooled, and chemical-cooled motors.

The largest air lines in the world would also be associated with the corporation and its affiliated interests. These include National Air Transport, from New York to Dallas, Texas; Pitcairn Lines, from New York to Miami; Transcontinental Air Transport, with lines from New York to Los Angeles, which will start operation in July; and the Aviation Corporation of America, which is included in the Hoyt group.

The ten firms in the merger are Wright Aeronautical Corporation, Curtiss Aeroplane & Motor Co., Inc., Curtiss Airports Corporation, Curtiss Flying Service, Inc., Curtiss Airplane Export Corporation, Curtiss Caproni Corporation, Curtiss-Robertson Airplane Mfg. Co., Keystone Aircraft Corporation, New York Air Terminals, Inc., and New York and Suburban Air Lines.

Certain groups connected with the various interests forming the new merger are not officially included in the consolidation. These are Moth Aircraft Corporation and Travelair Co., of the Hoyt-Wright interests, and the Douglas Aircraft Co., Inc., Sikorsky Aviation Corporation and Cessna Aircraft Co., of the Keys-Curtiss interests.

The company will have an authorized capitalization of 12,000,000 shares of no par value. Officials of the company have not yet been announced.

* * *

Wright to Make Super-Diesel Motor

The Wright Aeronautical Corporation has been licensed by the General Super-Diesel Motor Corporation to manufacture the new and improved type of aircraft engine patented and owned by the latter company. Claims made for this two-cycle motor are that its simplicity of design eliminates dangerous elements, of the four-cycle gasoline engine, that it will deliver 70 per cent more power than the four-cycle motor, and 50 per cent more power than a two-cycle crank case compression on an engine of the same piston displacement, with practically the same construction cost per pound. The specifications include: single action, radial design, hot-air injection, speed of 1,500 r.p.m., 45 brake hp. a cylinder, based on 85 lb. m.e.p., mechanical efficiency giving 400 brake horsepower.

Large Market Found for Equipment in Maintenance of Bus and Truck Fleets

THE large market for automotive parts, shop equipment, accessories and supplies created by the rapid growth of mass freight and passenger transportation by motor, is shown in the Survey of the Bus and Truck Fleet Market just completed by the Motor and Equipment Association. Great volume is possible in replacement items such as engine and chassis parts, because of wear resulting from the high mileages in bus and truck operation. For the same reason, shop-equipment installations and replacements run into large volume. Prepared in the interest of the wholesaler members of the association, the survey analyzes the purchases of typical fleets, large and small, and shows that despite considerable quantity purchasing by the larger fleet owners direct from manufacturers, there is a tremendous volume of business placed by fleets, large and small, with local sources of supply.

A detailed analysis of the bus market shows a total of 23,311 companies operating the 92,325 vehicles. Some companies run their buses 100,000 miles per year, but the general average is 40,000 to 50,000 miles, at a cost of $926.16 per bus, for the common carriers, for replacement parts. One company owning 320 buses purchased in one year one and one-half million dollars' worth of supplies and equipment, among which the following are sufficient to indicate the type of metal products to which a large part of the expenditures went:

Chassis springs	$24,000
Spark plugs	12,000
Axle parts	7,000
Piston rings	6,000
Anti-friction bearings	5,000
Connecting rods	3,000
Presses	2,000
Lathes	1,800
Air compressors	1,800
Bearing reamers	1,400
Portable electric drills	1,300
Wrenches	1,200
Lock washers	1,200

One company operating 112 buses stated that it had bought $20,000 worth of shop equipment; another operator with 65 buses has $50,000 worth, and spends $2,500 annually on new equipment.

Truck registration in the United States in the last ten years has multiplied by six, the figure in 1918 having been 525,000, while in 1928 it had increased to 3,397,000. Answers to a question as to shop equipment in use in truck service stations were received from 739 operating firms. Of these, 65 per cent had air compressors in use, 28 per cent had lathes, 79 per cent had portable electric drills, 10 per cent had cylinder reboring machines, 7 per cent cylinder regrinding machines, 47 per cent had welding outfits, 51 per cent had power drill presses, and so on. In fact, a surprising number of expensive pieces of equipment were reported. It is interesting to note that about 75 per cent of those companies operating ten or more trucks are operating their own service stations.

As a further index of the importance of the truck service market, there is tabulated below returns from a questionnaire requesting information as to investment in shop equipment and tools by these service stations. Out of 926 returns, 427 gave complete information as to the total investment in shop equipment and tools. These 427 reported as follows:

91	had invested	up to		$499
78	had invested	$500 to		$999
101	had invested	1,000 to	1,999
52	had invested	1,000 to	2,999
45	had invested	3,000 to	5,000
60	had invested	over	5,000

* * *

"Chicago Plan" for Sale of Used Equipment

At the June 21 meeting of the Machine Tool Distributors of the Chicago District, as announced last week in the *American Machinist*, the "Chicago plan" for the sale of used equipment was discussed. Under this plan discrimination has been eliminated from the purchase of used equipment in connection with the sale of new machine tools.

Very briefly, the plan maintains a central, disinterested bureau to which each member reports bids which he makes on used equipment. From this bureau any other member may obtain the figure bid, but not the name of the bidder. This second member may then bid higher, or meet the figure named. When this is done the bureau reports the higher figure, if any, and number of bidders, back to members who have made previous bids.

The net effect is to eliminate all uncertainty concerning the amount involved in the used machine transaction and to protect both buyer and seller in the transaction. M. A. Booz, of the Federal Machinery Sales Co., Chicago, is secretary of the Machine Tool Distributors Chicago group.

* * *

No Over-Production in Industry

Although industrial activity has been high so far this year, there is no evidence of industrial over-production, according to Col. Leonard C. Ayres, vice-president of the Cleveland Trust Co., as expressed in the June bulletin of the company. The phenominal output of automobile factories, in which the great volume of production of the Ford plant is the most important single factor, has been responsible for sustaining the high level of industrial activity. The iron and steel industry has benefited, as a result, and the business has been profitable rather than running to large tonnage. It appears that the output of automobiles in 1929 will exceed that of any previous year.

The building industry has not shared in the general prosperity, however, and new construction is now running about 20 per cent below that of the corresponding period of last year. Reports for the first quarter of 1929 show that industrial, utility and railroad profits are running from 30 to 40 per cent above those of the same period of last year.

* * * *

Machine Tool Plants Share General Improvement in British Industry

By Our London Correspondent

WE HAVE had our general election, the new government has been formed, and although new brooms may be expected to sweep clean, in a material sense no one appears so far to be a penny the better or worse. Most trade movements that were visible before the slight turmoil associated with the election campaign have continued without check. Thus, on the whole, industrial conditions appear to be improving, and, in particular, the betterment of conditions in the machine tool trade has extended and promises to develop still further.

With many aspects of the work of the new government we are not at all concerned in these columns, but its fiscal policy, owing to circumstances, is possibly more important both at home and abroad than has usually been the case. Although there may be some weak knees among the members of the party of which it is formed, the government as a whole must be regarded as definitely a free-trade government, and in that respect will receive full support from the smaller of the two other parties which technically will form the opposition. While promises are easily forgotten, it may be anticipated with some confidence that the so-called McKenna duties and, in fact, the various essays towards complete protection made by the last government, will be stopped or rather minimized. This will be a matter of special importance to the automotive industries, though the duties will probably be removed gradually in accordance with the conditions of the public revenue, and also, quite likely with the condition of

(Continued on page 36f)

BUSINESS BAROMETER

Large output in all lines continues to prevail, and only the agricultural depression beclouds the horizon

By THEODORE H. PRICE
Editor, Commerce and Finance, New York

THE United States Senate is adjourned until August 19. The House of Representatives has taken a holiday until September 23, and workers and business executives appear disposed to follow the example set by the National Legislature. The holiday habit seems to be spreading, and it is probable that this year's army of vacationists is larger than ever before in the history of the country.

The inference is that people have money to spend and that they are willing to spend it. This inference seems to be warranted, but the places left vacant by the absentees in industry and trade must have been filled for the output and turnover in most lines is amazingly large.

This is particularly true of the steel industry where bookings and shipments during May surpassed all records.

The same statement probably applies to a good many other basic industries, including particularly copper, rubber, and automobiles. In a survey of the rubber situation, the Union Trust Company of Cleveland states that the first half of 1929 will prove to be the most active six months period in the history of the tire and rubber industry.

Certainly, there is nothing except the agricultural depression to becloud the cheerfulness of the outlook, and even among the farmers the recent advance in grain has caused a better feeling. Whether this advance will be permanent or not remains to be seen. The surplus of wheat, including the Canadian production, is enormous, and optimism will be required to sustain prices when the weight of the crop now being marketed is acutely felt.

The same thing may be said of cotton. In the face of a crop prospect which seems to indicate a large yield, and a statistical position that is slightly bearish, the market has managed to sustain itself around 18c. for July contracts, and the buying that has been in evidence on each decline has proved sufficient to absorb the scattered offerings.

Rubber is slightly higher, but the other commodities speculatively dealt in are little changed. The cotton goods market has been quiet.

The stability of the stock market has surprised the skeptics. Call money has been up to 10 per cent, but speculators appear to be inured to this rate, and it has no longer any terror for them. Brokers' loans increased $122,000,000 during the week, to within $250,000,000 of the high point reached on March 20.

It seems absurd to assume that common stocks can continue to sell upon a 5% basis when money can be loaned at 10%, but the anomaly has already persisted much longer than many thought possible, and the judgment of the experienced has been so persistently defied that it no longer carries much weight with the generation who maintain that we are in a new era, and that American development should hereafter be discounted five or ten years in advance.

This theory is probably responsible for the ease with which the huge industrial consolidations recently formed have been put over. They include a combination of important food manufacturers, three public utility consolidations, a hotel consolidation that will probably involve properties worth at least fifty or one hundred million dollars, and a number of other lesser aggregations.

Describing the United States fifty years hence, or in the year 1979, a recent writer drew a picture of a country in which all the basic industries were consolidated into ten great corporations in whose stocks the inhabitants of Mars, Jupiter and Betelgeuse as well as those of the planet Earth were speculating.

It may be that we are approaching some such consummation, and a contemplation of it may be entertaining as we celebrate the Fourth of July, and the development that has followed the Declaration of Independence given to the world only 153 years ago. In that period our population has grown from about 2,600,000 to 120,000,000 and our wealth has multiplied so rapidly that it is impossible to count our gains.

There is no way of ascertaining whether the happiness of the people has been increased. Each generation thinks that it is happier than its predecessors, but in so far as material prosperity spells happiness there can hardly be any doubt that the America of today is better off than any other important nation of whose history we have knowledge.

Of course, our opulence and our extravagance have their dangers. For them we should be constantly on the watch, but the high cost of credit and the relatively low price that the farmer is receiving for the fruit of his labor are the only important blemishes in the present situation that are visible, and American resourcefulness ought to be able to deal with them.

In Europe the politico-economic view is, upon the whole, reassuring. In the British Empire great things are coming to be expected of MacDonald's labor minsitry, and its popularity appears to be increasing day by day.

From this page the reader will get a quick picture of current business and industry. The boxed material below is a summary of the letters from regional correspondents of the American Machinist, published in full on the opposite page.

JUNE reports from important centers show that the month has been active industrially, and the demand for machine tools and machinery is unabated.

IN MILWAUKEE, deliveries are four to six months behind. Farm machinery and small metal-working plants, paper and saw mills, and railroads are buying for expansion. Milling machine manufacturers are booked well into winter. Chicago business is good, although below June. Farm implement and tractor plants, notably International Harvester, are making purchases. Detroit has come back and reports the best six months in its history. A Pontiac foundry has bought $200,000 worth of motor equipment. In Cleveland, a big list has been issued by the Cleveland Union Terminal Co. for the Linnwood and Collinwood locomotive repair shops, and auto, tractor and machine plants are buying. At Buffalo, rolling mills are active and contractors' equipment is in demand. Rumors state that a European amphibian plane will be manufactured here, and Curtiss may have announcements of interest to machine builders. Some dealers in New York City have suffered a drop, but most lines are moving fast. June is well up to May, and summer prospects are unusually good. New England reports a better June than May in many lines. Pratt & Whitney has orders for 180 Wasp engines.

A FAVORABLE outlook is everywhere evident and, dealers are already beginning to look forward to another prosperous six months.

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THE INDUSTRIAL REVIEW

Weekly progress of the machinery and machine tool business

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

CHICAGO

Business in machine tools is practically on the same level as reported a week ago. In a few instances there has been noted an improvement but most manufacturers' agents and distributors say that, while not so active as in the early part of June, trade is well maintained. No recession is anticipated in the near future, other than that due to seasonal influences.

Inquiries still are being received in good volume, and are for all types of tools. Deliveries are little, if at all, improved, and midwest manufacturers of heavy duty machinery, as a rule, see small likelihood of catching up with orders for some months to come. Farm implement and tractor plants continue to buy freely, the International Harvester Co., in particular, having placed a number of orders for one of its large plants.

The greater percentage of business in machine tools noted at this time is coming from industrialists in the Middle West, the Chicago area contributing a full quota of orders. In woodworking equipment no signs of increasing business are reported, the year 1929 thus far having proved disappointing in demand to manufacturers of this line. Used tools still are called for in fair volume, with prices somewhat lower than obtained during the spring.

DETROIT

In spite of a general slowing up of production in almost all lines of industry, sales of machinery and machine tools have maintained a much higher level than was expected, and several of the outstanding dealers here report unusually heavy totals for June. One of the features of the past ten days was the sale of one order of motor equipment to a large Pontiac foundry. The deal involved approximately $200,000.

In general, the number of inquiries is encouraging for this time of the year. June and July are ordinarily the poorest months in the machinery trade here, and dealers are accustomed to a general slackening up. June has been much slower than April and May in some lines, but this has not been true throughout the trade. One dealer reports a better sales total for June than for either April or May, and even better than last June, which was unusually good. A number of other firms, especially those selling highly specialized equipment, have been reporting sales well above normal.

Most manufacturers, and aall of the machinery and machine tool dealers in this area, are convinced that 1929, as a whole, will be a record year. It is agreed, however, that the summer will be a dull period, comparatively, but there is a general belief that the fall will be unusually profitable. Many changes are being planned in the design of automobile motors and bodies, and these developments are expected to have a favorable effect on the machinery business. With the constantly increasing competition in the motor-car industry, alterations in design are becoming more and more frequent. There are rumors now of radical changes, but to date they are so far from being realized that manufacturers are not willing to discuss them.

General business is fairly good, but employment is decreasing. Business men, as well as manufacturers, however, are optimistic, and most observers are convinced that the last three months of this year are likely to be as prosperous as the first three months, or nearly so. The first half of 1929, as far as the machinery business is concerned, is probably the most prosperous six-months period in the history of the trade here.

MILWAUKEE

While purchases by the larger buyers are somewhat lighter in volume, and some manufacturers and dealers believe the peak has passed, others have not felt a lull and do not anticipate that one is impending. Orders from the smaller metal-working plants have not fallen off, nor do some manufacturers of milling machines expect to catch up with current orders until winter. Deliveries of machine tools are still from four to six months behind.

In automotive lines production is slightly relaxed. A tendency is noted on the part of automobile manufacturers to delay purchases and to question the continuance of present prices for machines and tools. Manufacturers of farm machinery are still ordering in the same volume and tractor manufacturers are buying more than ever. An increased demand is also noted from manufacturers of paper-mill machinery, feed grinders and sawmill equipment. Railroads, too, are still in the market in force. The employment index has not slipped back except for the automotive lines.

Proof that a continuance of high volume is generally expected, is afforded by steps taken by machine manufacturers to increase capacity on a permanent basis, and by new machine-shop specialty manufacturers who are just entering the field. Dealers also have expanded their facilities and are seeking new lines.

Drawbacks to the otherwise happy situation seem to consist solely in complaints about deliveries, with occasional forgetfulness regarding old orders on which delivery has been so long delayed that confusion is caused. Few cancellations, however, are reported because of delay in shipment.

CLEVELAND

No material change has been evident in the local machine tool industry for the past two weeks. Business continues to be spotty, with slight losses in a few instances, but, as a whole, the market is progressing in a satisfactory manner. The number of inquiries shows an increase. June business is reported as less than May. The first half of the year compares very favorably with the last half of 1928.

Among the outstanding features of the present market are: Increase in the number of inquiries, more activity in buying by the automobile industry, general purchasing by tractor, small machine shop and general industrial users, and the list of tools issued by the Cleveland Union Terminal Co., for the new Linndale and Collinwood locomotive repair shops.

Production schedules are being improved daily by tool builders in anticipation of a good fall business.

BUFFALO

For the first time in several months reports on the machine tool trade in the Buffalo district are variable among dealers. The general feeling seems to be that business is falling off somewhat, and that not much in the way of activity, considering that of early in the year as a standard, can be expected before September.

On the other hand, some dealers are experiencing an exceptionally good volume of business for June. Considerable business is being done, and is in sight, in heavy equipment such as is necessary in rolling mills. This has been a rather unexpected development and there is little to be learned about it at the moment. By and large, June is proving rather satisfactory as compared with Junes of recent years, but not so good as May.

The electrical equipment field activity is in line with that of machine tools. The large volume of spring business is definitely off, but there is a feeling that the early autumn will bring another big run of business. The demand for contractors equipment is probably as good now as it will be this year. Weather conditions are ideal for contractors and they are pushing work at a high rate.

Attention is still focused on the aircraft industry. It is safe to predict that one of the best-known aircraft production men in this country will announce within the next two weeks plans for another new plant in Buffalo, to manufacture a famous European-designed amphibian plane, with exclusive American production rights. Whether this plant will include the production of motors is not yet known. There is also a definite rumor that the Curtiss management will have something important to say about its line—something which will undoubtedly be of interest to machine-tool men.

CINCINNATI

The majority of the machine tool manufacturers of the Cincinnati district report that June sales were at a good level, although the total for the month was slightly less than that of May. In the past week, it is stated, business held up well and there is no indication that the trade is on the verge of any seasonal recession.

Selling agents report that during the week the demand continued to be good in local and adjacent territory. Business pending, it is stated, should keep sales at a good level with this branch of the trade through the present month, and the general outlook is regarded as favorable.

With the manufacturers, the sustaining feature of the week's business was a good volume of orders for single tools and replacements. The great majority of these were from general machinists and miscellaneous users, located in all sections of the country, whose requirements were well diversified in the matters of sizes and types. Likewise, the requirements of railroads and concerns in the automotive industry, and its allied trades, were, in the main, confined to single tools and replacements.

Inquiries flowed in freely during the week, the great majority coming from general machinists and miscellaneous users, whose requirements were largely confined to single tools and replacements. The inquirers were well scattered over the country and their needs were well diversified. No inquiries of importance are reported as having been

received from railroads or from the automotive field, but a number of requests for quotations on single tools and replacements came from both of these sources.

NEW YORK

In the New York area the machine tool situation shows no marked indication of a drop-off in either inquiries or orders. While some dealers are not finding markets very receptive, and a very few have not placed much equipment for the past week or two, the general trend is toward brisk business. Standard lines are selling well, and in the majority of cases June is proving to be as good a month as May, and about equal to the average for the past six months. Some dealers who experienced a slump early in the month, have closed an unusually large volume of orders in the latter part.

Orders continue to be spread over a wide variety of industries. Almost every type of machine tool is in demand. No large lots have been ordered and no new inquires are out for quantities of equipment. The few big lists previously opened for bids have not been closed, and may not be in the very near future. Small tools are not so active, but the situation is not alarming.

No price changes have been announced and none appear to be in prospect. Deliveries are still the bugbear of the trade, and no better, relatively, than for the past couple of months. New business is coming in so fast that no gain can be made in shipments, particularly during the summer season.

The general impression among dealers and manufacturers' representatives is that demand will continue active during all the summer. Present inquiries and orders bear out this belief. Expansion of plant capacities in most lines of industry is absorbing most of the new equipment sold, leaving replacement demand to be satisfied at a later date. Introduction of carboloy tools, likewise, promises to stimulate demand for modern machine tools, even after the present expansion demand is satisfied.

Demand for used machinery is strong. Dealers have only low stocks, and high production equipment is hard to get. Prices likewise are up. Plants having serviceable equipment are holding it until they can get deliveries on new machines.

Sales of the Triplex Machine Tool Co. for the past week include: one Oesterlein tool grinder, one Oesterlein universal miller, one nibbling machine, one six-spindle Edlund drill press, one Excel filing machine, one bench drill press, and one Triplex machine.

NEW ENGLAND

New England machine tool and machinery manufacturers, in specific instances, found new business for June totaling higher than May business. The month may be generalized as a remarkably full business month and far above the usual seasonal expectations. While the number of orders placed seems to have been considerably lower than recent best months, just as was the case through May and April, increased production in plants, together with the known great volume of unfilled orders, made possible the heavy output.

On the other hand, some instances of declines for the month, as compared with May, were noted, principally among the small tool manufacturers and contract shops. Labor indices in leading industrial centers incline upwards and skilled mechanics are very much in demand. Valuation of industrial products shipped continues to show an upward trend all of which is indicative of healthy business.

Orders for the week included high speed lathes, milling machine, jig-boring equipment, power hammers, grinding machines (with eastern aeronautical companies the principal buyers), presses, automatic screw machines, horizontal drill, a shaper and woodworking equipment by a Massachusetts company, including band saw, and wood lathes. The Pratt & Whitney Aircraft Co., added orders for 180 Wasp engines.

PHILADELPHIA

Conditions in the machinery and machine tool industry throughout the Philadelphia market were somewhat spotty last week. In some instances reports were that the summer tapering off in orders has set in, while, in others, shops were busy getting out orders received despite the approach of the warm season and the nearness to inventory time when industries are desirous of keeping down their stocks.

Philadelphia dealers have felt the effect of Southern industrial development, and some substantial orders for machine tools and equipment have come from that section. Dealers in and manufacturers of leather belting for shop equipment report the situation favorable. The first six months of this year will be from 15 to 20 per cent better in that line than the corresponding period of last year.

Manufacturers of ball bearings have found the automotive industry buying quite freely, and there have been some sales to airplane manufacturers in this market. Some railroad buying for replacement of shop equipment was reported, and orders came from industrial lines in fair volume for Eastern seaboard delivery.

Sales of woodworking machinery and of machinery used in the production of textiles have fallen off somewhat. Inquiries have been fair.

The American Engineering Company secured an order for 47 hoists from the Chesapeake and Ohio Railway Co., consisting of 31 one-ton hoists and 16 two-ton hoists.

* * *

Machine Tool Plants Share British Prosperity

(*Continued from page 36c*)

the industry which is directly concerned.

Forced on by one of the other political parties, but not only for that reason, the new government must attempt to deal with the serious problem of unemployment, and a special minister has been appointed to that end. In one or two directions his policy may be anticipated from past utterances. In all probability the number of people on the labor market will be definitely reduced, at the one end by raising the school-leaving age from 14 years, as now, to 15 years, thus keeping out many youthful entrants, while at the other end an extension of the pensions schemes will remove some who still remain at work, or would do so if they could find it. This cannot be done for nothing. Maintenance grants for the young, where needed, will also swell the expense, and, taking into account other matters, the taxpayer cannot anticipate any lessening of his burden.

The fairly general feeling that trade has improved is borne out by the Board of Trade figures relating to overseas trading. It is further confirmed by the figures issued by the National Federation of Iron and Steel Manufacturers on the production of pig iron and steel. Thus, while the imports for the first five months of this year surpassed in value the imports for the corresponding period of 1928 by more than 7½ million pounds or 1½ per cent, the 1929 exports similarly exceeded the 1928 exports by rather more than 13 million pounds or 4½ per cent. On the other hand, the value of re-exports, that is, of imported merchandise, shows a corresponding decline of about 9 per cent, due it is stated, almost entirely to a fall in the value of raw materials.

The latest figures of pig iron production show that at the end of May 159 furnaces were in blast, a net increase of 7 during the month, the production of pig iron amounting to 654,800 tons, as compared with an average monthly output during 1928 of 550,900 tons, or of 607,700 tons in 1927. A fairly steady increase has, in fact, been shown since the middle of last year, though the pre-war monthly average of 855,000 tons has not been reached. Similarly, the output of steel ingots and castings during May was 840,400 tons, having also steadily risen since the middle of 1928, and comparing with a monthly average for that year of 710,400 tons, a monthly average of 758,100 tons in 1927, and a pre-war monthly average of but 638,600 tons.

Other Industries Improving

A rapid glance at the engineering industries suggests that in general engineering the conditions are not quite satisfactory, but are improving. In shipbuilding, some uncertainty is shown, for many of the prices obtainable in the last year or two have not been remunerative, and yet it has been impossible to raise them. On the other hand, orders have been accepted and, since the yards are busier, claims have been made for wages increase, and the prices of steel plates and other materials have been definitely raised. The electrical industry may be regarded as fully employed, though company reports bear out the suggestion that overseas competition, at least as regards prices, is extremely keen. The motor industry has had a fairly satisfactory season, which has continued beyond the usual period The commercial vehicle section, on the whole, has been quite prosperous and the various dominions and Japan are reported as providing good markets for motorcycles. Though the home demand for textile machinery has not been good, certain of the European and Asiatic markets have provided work.

Nothing really new can be said about the machine-tool industry. On the whole, there is a definite movement in the right direction, though in some districts orders are still rather unevenly distributed. Manufacturers of heavy equipment, if not exactly pressed, share in the improvement, and the prospect is more hopeful. Competition, in some lines at least, has been greatly lessened by the definite closing-down of certain firms during the past few years. But it is in this section of the industry that the most emphatic complaints are made regarding price under-cutting, complaints for which clear evidence can be found.

The exhibition of machine tools organized by the Machinery (Machine Tool and Woodworking) Importers' Association of Great Britain, and held in conjunction with an international foundry trades exhibition at the Agricultural Hall, Islington, N., from June 5

to June 15, was moderately attended. On the stands of about a dozen firms, half a dozen or so British and American tools were included, and a few Swiss tools, but the majority were of German origin and most of them would be familiar to visitors to the Leipzig spring fairs of the last two years

* * *

South America Good Buyer of Machinery in 1928

Brazil in 1928 took $649,160 of American metal-working machinery, an increase of nearly 15 per cent over exports to that country in 1927. The more important individual items making up the total of shipments to Brazil were: pneumatic portable tools; milling machines; engine lathes; radial drilling machines; vertical boring mills and chucking machines; taps, dies and screw plates; planers and shapers; external cylindrical grinding machines; metal-working-tool sharpening machines.

The principal items making up the $524,694 of metal-working machinery sent to Argentina last year, in the order of the amount shipped, follow: taps, dies and screw plates; sheet and plate metal-working machinery; thread-cutting and automatic screw machines; pneumatic portable tools; forging machinery; drills and reamers; foundry and molding equipment; cutters and metal-working tools; knee and column-type milling machines; engine lathes; external cylindrical grinding machines.

PURCHASES BY OTHER COUNTRIES

Chile, in 1928, bought $206,274 of metal-working machinery. The purchases, in the order of their importance, follow; power-driven metal-working machinery; taps, dies, screw plates; metal-working-tool sharpening machines; engine lathes; pneumatic portable tools; portable and hand- or foot-operated machinery.

The principal items making up the $164,512 of metal-working machinery sent to Venezuela last year, in the order of the amount shipped, follow: power-driven metal-working machinery; turret lathes; taps, dies and screw plates; cutters and other metal-working machinery; portable and hand- or foot-operated metal-working machinery; sheet and plate metal-working machines.

Colombia, in 1928, brought $136,579 of metal-working machinery. The purchases, in the order of the importance, follow: power-driven metal-working machinery; pneumatic portable tools; taps, dies, screw plates; engine lathes.

Peru, in 1928 bought $120,844 of metal-working machinery. The purchases, in the order of their importance, were: power-driven metal-working machinery; pneumatic portable tools; power and hand- or foot-operated machine tools; metal-working-tool sharpening machines; thread-cutting and automatic screw machines.

Westinghouse Elects F. A. Merrick President

F. A. Merrick, for a long time associated prominently with the electrical industry, has been elected president of the Westinghouse Electric & Manufacturing Co. He succeeds E. M. Herr, who has been president since 1911, and who has resigned to go on an extended vacation necessitated by his health.

Mr. Merrick was elected to the presidency from the office of vice-president and general manager. After he was graduated from Lehigh University, he

F. A. Merrick

entered the employ of Steel Motors Co., a subsidiary of Lorain Steel Co., and later held the position of manager and chief engineer. Here he developed many important electrical inventions. When the Westinghouse company acquired the Steel Motors Co., Mr. Merrick was appointed to prepare plans for a Canadian plant. In 1903, upon the formation of the Canadian Westinghouse Co., Ltd., he was sent to Canada as superintendent

E. M. Herr

of the company, later becoming manager of works and finally vice-president and general manager.

During the World War Mr. Merrick was in charge of operations of the New England Westinghouse Co. Subsequently he was located in London as special representative of the Westinghouse Electric International Co., for a period of two years. Then he returned to Canada as vice-president and general manager of the Canadian Westinghouse Co., Ltd. In January, 1925, Mr. Merrick was elected vice-president and general manager of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., and also a director of the company. His offices will be in Pittsburgh.

* * *

Worcester Warner Dies After Active Life

Worcester Reed Warner, who was a past president of the A.S.M.E. and a member of the Warner & Swasey Co., died June 25 at Eisenbach, Germany, following a heart attack. He was 83 year old.

Mr. Warner was born at Cummington, Mass., in May, 1846, beginning his engineering career at the age of 19 when he went to Boston and secured employment in the engineering office of

Worcester Reed Warner

George B. Brayton, one of the most eminent mechanical engineers of his time. The following spring the offices were moved to Exeter, N. H., where Mr. Warner became Mr. Brayton's assistant in the design and construction of Brayton boilers and engines.

In 1869, Mr. Warner entered the employ of the Pratt & Whitney Co., of Hartford, Conn., where he remained eleven years, eight of them as a department foreman. During that time he devoted much of his time to the pursuit of his favorite scientific studies, especially astronomy, and experimented with telescope building as a recreation, thereby anticipating what later brought him world fame.

In 1881 he associated himself with his old friend and shopmate, Ambrose Swasey, establishing the machine tool firm of Warner & Swasey in Cleveland, Ohio. This later became The Warner and Swasey Co. Owing to Mr. Warner's studies in astronomy, it became evident to him that with the increase in the size of telescope lenses, the mounting of them had come to be a work of engineering, properly to be undertaken by his firm. Under his direction, the company designed and constructed many of the largest telescopes in existence, in-

cluding the 36-in. Lick, the 72-in. one of the Dominion Observatory of Canada, the 60-in. telescope of the Argentine National Observatory, and many others, beside the astronomical equipment for many colleges and universities of the United States and foreign countries. He also interested himself in the design and construction of instruments of precision for the U. S. Government, such as range-finders, gunsights, field telescopes, besides the company's regular line of machine tools.

Mr. Warner has received a number of honors in recognition of his distinguished work in his chosen field. In 1897 he received the degree of doctor of mechanical science, and in 1925 that of doctor of engineering. He was a fellow of the American Association for the Advancement of Science, and a member of both the British and American Astronomical Societies. In addition to his membership and past presidency of the A.S.M.E., he was past president and honorary member of the Cleveland Engineering Society, and a trustee of Western Reserve University and the Case School of Applied Science of Cleveland.

Mr. Warner maintained a complete machine shop and astronomical observatory at his home at Tarrytown-on-Hudson, N. Y., which he used for the continuance of his studies and inventions in mechanical and scientific fields. At the time of his death, he was on a sightseeing trip covering several of the European countries.

Business Items

The Surface Combustion Co., Toledo, Ohio, is adding 35,000 sq. ft. of floor space to its production plant as a result of increased business. The addition, when complete, will make the total floor area 90,000 sq.ft. The plant includes an office, laboratory, factory and storeroom. The factory contains a machine shop, sheet metal dept., refractory dept., house-heating burner assembly dept., an assembly floor for steel fabrication and inspection, and a shipping department. The company is also opening a district sales office in Kansas City, Mo., this month in charge of W. H. Kay, to handle business in Kansas, Nebraska, Wyoming, Colorado, Utah, Missouri with the exception of St. Louis, and a portion of Texas.

The Biflex Products Co., subsidiary of the General Springs Bumper Co., a Houdaille-Hershey Corporation unit, announces that the manufacture of bumpers, which has been conducted in the Waukegan plant of the company, will be transferred to the Decatur, Ill., plant early in August. Manufacturing operations of the company are being concentrated in the Decatur, Detroit and Chicago plants. The Decatur factory is being rearranged to accommodate the new line. This plant is now operating with a force of 450 workers, and many departments are on a seven-day basis with day and night shifts. A. F. Grimm is vice-president of the Biflex Products Co., in charge of the Decatur plant.

The Reed Roller Bit Co., Houston, Tex., is planning to start an extensive enlargement program within the next few months following the recent acquisition by the company of a site adjacent to its present plant in Houston, the expansion program to extend over a period of about five years and entail a total investment of around $5,000,000, including a large drop forge plant. The announcement was made by W. L. Childs, vice-president and manager.

The Gardner Motor Co. is expanding its facilities in order to handle the production of a new low-priced car for Sears, Roebuck & Co., Chicago mail order house, to retail around $500, and a front-drive car for an eastern company. Production of these cars will not begin for six or eight months. The Parks Aircraft Co., subsidiary of Gardner Motors, is also being expanded to increase production on new models which have been introduced.

The Atlanta Aircraft Corporation, recently organized in Atlanta for the manufacture of airplanes, has leased a tract at Candler field and expects shortly to start the construction of the initial unit of the plant. This unit is expected to represent an investment of about $25,000, not including machinery and equipment. The company is composed of prominent Atlanta business men and has a capitalization of $300,000.

The Indian Motocycle Co., Springfield, Mass., will enter the aeronautical field to manufacture engines for water- and aircraft, according to an announcement of J. Russell Wait, president, who recently succeeded Louis E. Bauer as head of the company. The present plant is well adapted for the manufacture of internal combustion engines, and a subsidiary concern will be organized for this purpose.

The Miami Engineering Co., Dayton, Ohio, which has qualified as a Wisconsin corporation, plans to build a Milwaukee plant within the coming year for the manufacture of tools, jigs, dies and special machinery. About 100 men are to be employed. For some time a staff of engineers and draftsmen has been maintained at Milwaukee for designing these items.

The Ford Motor Co. will enlarge the floor space of its Dearborn (Mich.) airplane factory 155 per cent to make possible the production of one trimotored plane a day.

The Standard Machinery & Supply Co., Boston, Mass., formerly at 124 Broad St., has moved into larger quarters at 218-220 High Street.

The Heald Machine Co., Worcester, Mass., has under construction an addition to its factory. The new building will be 105x360 ft. of steel and brick construction, with saw tooth roof. It will house offices, tool room, experimental and service departments, and allow the entire present shop to be devoted to manufacturing purposes.

The Central Alloy Steel Corporation, Massillon, Ohio, has appropriated $450,000 to add improvements to its mill turning out sheet steel for the automotive industry. An increase of 15 per cent in shipments has been recorded during the first five months of this year, over that for the same period during 1928.

The Larrabee Machine Works, Inc., 2005 Montgomery St., Fort Worth, Tex., was chartered the latter part of April with a capital stock of $60,000, and is reported contemplating erection of a plant to manufacture oil well machinery and tools. The company is headed by George Larrabee.

The Southern Wesix Co., a subsidiary of the National Wesix Co., San Francisco, Calif., manufacturer of water and air heaters, has established a branch plant at 617 N. Tenth St., Birmingham, Ala., to manufacture and distribute the company's products in the Southeast.

The Houdaille-Hershey Corporation is expanding the manufacturing facilities and equipment of its plant at Buffalo, N. Y., as a result of increased business. The company operates plants at Chicago, Buffalo, Detroit and Indianapolis.

The Snap-On Wrench Co. and the Blue Point Tool Co., both of Milwaukee, Wis., and controlled by the same interests, will be consolidated with the building of a new plant this year. The expansion program will call for a doubling of the present force of 250.

The Continental Can Co., New York City, has acquired the business and assets of the Federal Can Co. of Nashville, Tenn.

R. A. Rearwin Airplanes, Inc., of Kansas City, Mo., is planning a new plant at Fairfax Airport to cost $500,000.

Personals

KARR PARKER, treasurer and engineering manager of McCarthy Brothers and Ford, of Buffalo, N. Y., was elected president of the Westinghouse Agent Jobbers Association at the 17th annual meeting held June 10 to 15 at Hot Springs, Va. E. D. KILBURN, vice-president and general sales manager of the Westinghouse Electric & Manufacturing Co., was elected vice-president. H. M. GANSMAN, vice-president of the H. C. Roberts Electric Supply Co. of Philadelphia, was elected secre-

tary, and H. T. PRITCHARD, of the Merchandising Department of the Westinghouse company at Mansfield, Ohio, was elected assistant secretary and treasurer.

WILLIAM G. MARSHALL, has been appointed assistant to vice-president T. P. GAYLORD of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. He will be in charge of employees relations. The positions of director of personnel and manager employees service will be continued as heretofore. Mr. Marshall since 1926 has been director of personnel for the

Philadelphia Co. and affiliated corporations. He received his A. B. degree from Washington and Jefferson College in 1911, and afterward attended the University of Pittsburgh Law School, being graduated from it in 1914. Following his graduation he was connected with the law offices of Burleigh & Challener up to 1916, when he joined the staff of the Philadelphia Company.

H. W. NEWTON has been appointed district manager of the Birmingham (Ala.) office of the Stephens-Adamson Manufacturing Co., Aurora, Ill. Mr. Newton succeeds W. E. Harris. He will have offices at 1108 Martin Building. Mr. Newton has been with the Stephens-Adamson Co. for several years in the capacity of designing engineer.

JOHN GWILLIAM has been elected president of the Gwilliam Co., 360 Furman St., Brooklyn, N. Y., manufacturer of ball and roller bearings. He was formerly vice-president. MARK R. M. GWILLIAM has been made vice-president, while MAURICE B. WELSH continues as secretary.

S. BRACKEN has been appointed assistant engineer of manufacture of the Hawthorne (Chicago) Works of the Western Electric Co., 195 Broadway, New York. He was formerly operating superintendent, and succeeds the late Edward D. Hall.

H. L. ANDREWS is now head of the transportation engineering department of the General Electric Co., formerly known as the railway engineering department. Included in and as divisions of this department will be the railway equipment, air brake equipment and industrial locomotive engineering departments at the Erie (Pa.) Works, and the automotive engineering department at the Lynn (Mass.) River Works. W. B. Potter is consulting engineer of the department.

ARTHUR CHEVROLET of Indianapolis, one of the Chevrolet brothers, has announced the development of a light four-cylinder, air-cooled, inverted, aviation motor, having duplicate working parts. The engine weighs 325 lb., and will develop 150 hp. at 2,700 r.p.m.

F. L. REYNOLDS has been appointed West Michigan representative for the Allen-Bradley Co., manufacturer of electric controlling apparatus, of Milwaukee, Wis. Mr. Reynolds will have headquarters at 4143 Ellsworth Ave., Grand Rapids, Mich.

E. F. TALMAGE, formerly connected with the Holcomb Steel Co., at Cleveland, Ohio, has become associated with the Timken Steel & Tube Co., as district sales manager, at 360 N. Michigan Ave., Chicago.

EDWARD P. WARNER, former assistant secretary of the navy for aeronautics, has been nominated for the presidency of the S. A. E. Nomination is practically equivalent to election.

O. H. BROXTERMAN, formerly president of the John Steptoe Co., Cincinnati, machine tool builder, has established his own business as manufacturer's agent in that city.

HARRY R. DEHOLL, Indiana Harbor, Ind., has been designated as Indiana agent for the Inland Steel Co., a Delaware corporation.

C. M. LOEB, president of the American Metal Co., has resigned. His successor has not been announced.

Obituaries

WILLIAM A. MCDONALD, of the sales force of the E. L. Essley Machinery Co., Chicago, died recently as a result of injuries sustained in an automobile accident near Waukesha, Wis., on June 12. Mr. McDonald had been with the company for 16 years, and was a brother of J. R. McDonald, vice-president of the company. Mr. McDonald was 55 years old.

EDWARD H. BINDLEY, president of the Bindley Nut & Bolt Co., and vice-president of the Pittsburgh Steel Co., died June 21 at his home in Pittsburgh. He was 50 years of age.

CHARLES H. DOELGER, 64 years of age, a member of the firm of Doelger-Kirsten, manufacturer of all-steel shears, died at his home in Milwaukee, June 25, after an illness of six months.

FRANK HICKMAN, chairman of Buck & Hickman, Ltd., Whitechapel Road, London, E., England, agents for American machine tools, etc., died on June 3 at the age of 62. The firm was founded by his father, J. R. Hickman, and the late chairman had been connected with it for nearly 50 years.

ROBERT W. REED, secretary of the Mullins Body & Tank Co., Milwaukee, Wis., maker of steel equipment, died June 18 at the age of 40 years. His father was William J. Reed, president of the Reed-Waite Co., Milwaukee, manufacturer of automobile equipment.

J. P. SCHNEIDER, general manager of the American Tool and Manufacturing Co., Urbana, Ohio., died recently from a stroke of apoplexy. He had been connected with the company since 1914, and was also a member of the A.S.M.E.

EDWARD S. DAVIS, president of the Davis Tool and Engineering Co., died on June 24, at the age of 48 years, of heart trouble.

Forthcoming Meetings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Third national meeting of the Iron and Steel Division, during the Steel Treaters' Exposition, Cleveland, September 11-13. Calvin W. Rice, secretary, 29 West 39th St., New York City.

NATIONAL METAL CONGRESS. To be held in Cleveland September 9 to 13. Simultaneous meetings of the American Welding Society, the Institute of Metals Division, American Institute of Mining & Metallurgical Engineers, Iron & Steel Division, American Society of Mechanical Engineers, the Iron & Steel Division, A.I.M.E., and the American Society for Steel Treating. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland, Ohio.

NATIONAL METAL EXPOSITION. Eleventh annual, held under the auspices of the American Society for Steel Treating, Cleveland Public Auditorium, Cleveland, Sept. 9-14. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland.

MACHINE TOOL BUILDERS EXPOSITION. Under the auspices of the National Machine Tool Builders Association, Sept. 30 to Oct. 4, in the Public Auditorium, Cleveland, Ohio. Ernest F. DuBrul, general manager, 826 Provident Bank Bldg., Cincinnati.

MACHINE TOOL CONGRESS. In connection with the exposition of the National Machine Tool Builders' Association, to be held Sept. 30 to Oct. 4, in the Public Auditorium, Cleveland, Ohio, a national machine tool congress will be conducted under the joint leadership of the S.A.E. and the Machine Shop Practice Division of the A.S.M.E.

THE WEEKLY PRICE GUIDE . . .

Rise and Fall of the Market

STEEL shapes and plates are in active demand, with bars, tin plates, automotive and agricultural implement material tapering off considerably in the buying. Mill operations continue at peak levels. A fair volume of purchasing appears for delivery in the current quarter, maintaining the mill base of $1.95 per 100 lb., Pittsburgh, on the principal hot-rolled products. Slightly higher prices are expected on small quantity mill shipments for the third quarter. Pig iron declined 50c. per ton at Cincinnati, New York, Birmingham, Chicago and Pittsburgh. Antimony is down ¼c. per lb. at New York warehouses. Major advances of the week were: 0.1c. per lb., slab zinc at East St. Louis; 1c. per lb., zinc sheets, New York; ¼c. per lb., solder, New York; 0.2c. per lb., linseed oil, New York; 0.3c. per lb., linseed oil, Chicago.

(*All Prices as of June* 28, 1929)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b:

CINCINNATI	
No. 2 Southern (silicon 1.75@2.25)	$18.44
Northern Basic	20.89
Southern Ohio No. 2	21.19
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 1.75@2.25)	20.75
BIRMINGHAM	
No. 2 Foundry (silicon 1.75@2.25)	15.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.76)	21.76
Virginia No. 2	24.79
Basic	20.76
CHICAGO	
No. 2 Foundry local (silicon 1.75@2.25)	20 00
No. 2 Foundry, Southern (silicon 1.75@2.25)	20.76
PITTSBURGH, including freight charge ($1.76) from Valley:	
No. 2 Foundry	19.76
Basic	19.26
Bessemer	21.26

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb:

Detroit	4.50
Cleveland	5.00
Cincinnati	4.50
New York	5.25
Chicago	4.50@4.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots:

Blue Annealed	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	2.20	3.35	3.25	3.90*
No. 12	2.25	3.45	3.30	3.95*
No. 14	2.35	3.55	3.35	4.00*
No. 16	2.45	3.65	3.45	4.10*
Black				
Nos. 18 to 20	2.65@2.75	3.85	3.70	3.80
No. 22	2 80@2.90	4.00	3.85	3.95
No. 24	2.85@2.95	4.05	3.90	4.00
No. 26	2.95@3.05	4.15	4.00	4.10
No. 28	3.10@3.20	4.75	4.15	4.25
Galvanized				
No. 10	2.80@2.90	4.20	4.05	4.05
Nos. 12 to 14	2.90@3.00	4.30	4.15	4.15
No. 16	3.00@3.10	4.40	4.25	4.25
No. 18	3.15@3.25	4.55	4.40	4.40
No. 20	3.30@3.40	4.70	4.60	4.55
No. 22	3.35@3.45	4.75	4.65	4.60
No. 24	3.60@3.70	4.90	4.75	4.75
No. 26	3.75@3.85	5.15	5.00	5.00
No. 28	4.00@4.10	5.40	5.25	5.25

*Up to 3,999 lb.

WELDED STEEL PIPE—Warehouse discounts are as follows

	New York		Cleveland		Chicago	
	Black	Galv.	Black	Galv.	Black	Glav.
1 to 3 in., butt welded	50%	36%	55½%	43½%	54%	41%
2½ to 6 in., lap welded	45%	32%	53½%	40½%	51%	38%

WROUGHT-STEEL PIPE LIST

Size, Inches	List Price per Foot	—Diameter in Inches— External	Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at New York warehouse in lots of less than 100 ft. or 100 lb:

— Thickness — Decimal	B.w.g. and Fractions	Outside Diameter in Inches ½	⅝	¾	⅞	1	1⅛	1¼
		Price per Foot						
.035"	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049"	18	.17	.18	.19	.20	.21	.23	.25
.065"	16	.19	.20	.21	.22	.23	.25	.27
.083"	14	.20	.22	.23	.24	.25	.27	.29
.095"	13	.21	.23	.25	.26	.27	.29	.31
.109"	12	.22	.24	.26	.27	.28	.30	.32
.120" or .125"	11	.23	.25	.27	.28	.29	.31	.33
.134"	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse base prices in cents per lb:

	New York	Cleveland	Chicago
Spring steel, light*	4.50	4.65	4.65
Spring steel, heavier	4.00	4.00	4.00
Coppered Bessemer rods	6.05	6.00	6.20
Hoop steel	4.25†	4.00	4.15
Cold rolled strip steel	6.25	6.00	6.10
Floor plates	5.10†	5.30	5.00
Cold drawn, round or hexagon‡	3.50	3.65	3.60
Cold drawn, flat or square‡	4.00	4.15	4.10
Structural shapes	3.30†	3.00	3.10
Soft steel bars	3.25†	3.00	3.00
Soft steel bar shapes	3.25†	3.00	3.00
Soft steel bands	3.75†	3.65	3.65
Tank plates	3.30†	3.00	3.10
Bar iron (2.75 at mill)	3.24	3.00	3.00
Drill rod (from list)	60%	55%	50%

*Flat, $\frac{3}{16}$-in. thick. †Up to 3,999 lb., ordered and released for shipment at one time. ‡Cold finished steel, shafting and screw stock.

Electric welding wire at New York warehouse— $\frac{3}{32}$, 8.35c. per lb.; $\frac{1}{8}$, 7.85c. per lb.; $\frac{5}{32}$ to $\frac{1}{4}$, 7.35c. per lb.

METALS

Warehouse Prices in Cents Per Pound for Small Lots:

Copper, electrolytic, New York			19.25
Tin, Straits, pigs, New York			47.50
Lead, pigs, E. St. Louis	6.80	New York	8.25
Zinc, slabs, E. St. Louis	6.80	New York	8.25

	New York	Cleveland	Chicago
Antimony, slabs	11.25	13.00	14.25
Copper sheets, base	27.75	27.75	27.75
Copper wire, mill, base	19.87½	19.87½	19.87½
Copper, drawn, round, base	26.25	26.25	26.25
Copper tubing, base	29.25	29.25	29.25
Brass sheets, high, base	23.25	23.25	23.25
Brass tubing, high, base	28.25	28.25	28.25
Brass rods, high, base	21.25	21.25	21.25
Brass wire, high, base	23.75	23.75	23.75

SHOP MATERIALS AND SUPPLIES

METALS—Continued

	New York	Cleveland	Chicago
Aluminum ingots, 99%.....	25.00*	24.30	24.30
Zinc sheets (casks).....	11.50	11.70	10.11
Solder (⅛ and ¼).....	32.50	32.75	31@34
Babbitt metal, delivered in case lots, New York, cents per lb:			
Genuine, highest grade.....			62.00
Commercial genuine, intermediate grade.....			45.00
Anti-friction metal, general service.....			31.50
No. 4 babbitt.....			12.00

*Delivered.

NICKEL AND MONEL METAL—Price in cents per lb., base, f.o.b. Huntington, W. Va:

	Nickel	Monel Metal
Sheets, full finished.....	52.00	42.00
Sheets, cold rolled.....	60.00	50.00
Strip, cold rolled.....	55.00	45.00
Rods, hot rolled.....	45.00	35.00
Rods, cold rolled.....	53.00	40.00†
Tubing	75.00*	90.00
Angles, hot rolled.....	50.00	40.00
Plates.....	52.00	42.00

*Seamless. †Cold drawn.

OLD METALS—Dealers' purchasing prices in cents per pound, f.o.b. cars, depending on quantity offered for sale:

	New York	Cleveland	Chicago
Crucible copper.....	15.25 @15.50	13.50	13.00 @14.00
Copper, heavy, and wire..	14.00 @15.25	13.00	12.00 @13.00
Copper, light, and bottoms	12.50 @13.00	12.50	11.00 @12.00
Heavy lead.....	5.37½@ 5.62½	6.25	5.00 @ 5.50
Tea lead.....	3.75 @ 4.25	4.25	4.00 @ 4.50
Brass, heavy, yellow.....	8.50 @ 9.00	8.00	8.00 @ 8.50
Brass, heavy, red.....	.....	12.50	12.00 @12.50
Brass, light.....	7.00 @ 7.50	7.50	8.00 @ 8.50
No. 1 yellow rod turnings.	9.50 @10.00	9.00	10.00 @10.50
Zinc.....	3.25 @ 3.50	3.25	3.00 @ 3.25

TIN PLATES—Charcoal—Bright—Per box:

	New York	Cleveland	Chicago
"AAA" Grade:			
IC, 14x20.....	$12.10	$11.95	$11.50
"A" Grade:			
IC, 14x20.....	9.70	9.90	9.50
Coke Plates—Primes—Per box:			
100-lb., 14x20.....	6.45	6.10	7.00
Terne Plates—8-lb. Coating—Small lots—Per box:			
IC, 14x20.....	7.75@8.00	7.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.*	$0.10@0.13½	$0.16	$0.15
Cotton waste, colored, per lb.*	.09@ .13	.12	.12
Wiping cloths, washed white, per lb.†.....	.16	38.00 per M	.16
Sal soda, per lb.....	.02¼	.02	.02
Roll sulphur, per lb.....	.027	.03½	.04
Linseed oil, raw, in 1 to 4 bbl. lots, per lb.....	.115	.11	117
Cutting oil, about 25% lard, in 5 gal. cans, per gal.....	75	.60	.65
Machine oil, medium-bodied (55 gal. steel bbl.) per gal..	.33	.36	.35
Belting — Present discounts from list in fair quantities (½ doz. rolls) for leather or rubber:			
Leather—List price, 24c. per lin. ft., per inch of width, for single ply:			
Medium grade.....	30–10%	30–10%	35%
Med. grade, heavy wgt...	30– 5%	30– 5%	30%
Rubber transmission, 6-in., 6 ply, $1.83 per lin.ft:			
First grade.....	50%	50–10%	50%
Second grade.....	60%	60– 5%	50–10%

*All waste in bale lots. †100-lb. bales.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars.....	per lb..	$0.0325	$0.0325	$0.0325
Cold drawn shafting...	per lb..	.035	.035	.034
Brass rods.....	per lb..	.2125	.2125	.17
Solder (⅛ and ¼).....	per lb..	.325	.325	.315
Cotton waste, white...	per lb..	.10@.13½	.10@.13½	.10@.13½
Disks, aluminum oxide mineral, cloth, No. 1, 6-in. dia.....	per 100.	3.60	3.60	3.10
Lard cutting oil.....	per gal.	.75	.55	.65
Machine oil.....	per gal.	.33	.33	.30
Belting, leather, medium.....	off list..	30–10%	30–10%	31½%
Machine bolts, up to 1x30 in., full kegs...	off list..	50-10%*	50–10%*	50%*

*List prices as of April 1, 1927.

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials — Standard grade, in sheets 9x11 in., No. 1, per ream of 480 sheets:			
Flint paper.....	$4.50	$4.29	$4.29
Emery cloth.....	22.93	20.97	20.97
Disks, aluminum oxide mineral, 6 in. dia., No. 1, per 100:			
Paper.....	2.64	2.04	2.04
Cloth.....	3.60	3.59	3.59
Fire clay, per 100 lb. bag.....	1.00	.75	.75
Coke, prompt furnace, per net ton...	Connellsville, 2.75@2.85		
Coke, prompt foundry, per net ton...	Connellsville, 3.75@4.50		
White lead, dry or in oil...	100 lb. kegs....	New York,	13.75
Red lead, dry.....	100 lb. kegs....	New York,	13.75
Red lead, in oil.....	100 lb. kegs....	New York,	15.25

SHOP SUPPLIES

Discounts from new list dated Apr. 1, 1927, applying on immediate deliveries from warehouse stocks in New York and vicinity:

Machine bolts:	
Up to ¾-in. x 6-in., full kegs, list less.....	60%
Larger, up to 1 x 30-in., full kegs, list less.....	50–10%
Less than full kegs or case lots, add to list.....	10%
Fitting-up bolts: list less.....	45%
Lag screws:	
Up to ½-in. x 6-in., list less.....	60%
Larger, list less.....	50–10%
Less than full keg or case lots, add to list.....	10%
Rivets:	
Structural, round head, full kegs, net.....	$4.50
Structural, round head, broken kegs, net.....	6.00
Tank, 7/16-in. dia. and smaller, list less.....	60%
Nuts:	
Hot pressed, square or hexagonal, blank or tapped:	
Full kegs up to 1-in., incl., list less.....	60%
Larger, up to 3-in., list less.....	40–10%
Less than keg or case lots, add to list.....	10%
Washers:	
Wrought, full kegs, per 100 lb., list less.....	$4.00
Wrought, broken kegs, per 100 lb., list less.....	2.00
Turnbuckles:	
With stub ends, list less.....	20%
Without stub ends, list less.....	50%
Chain:	
Proof coil, base, per 100 lb., net.....	$7.10
Cast iron welding flux, per lb., net.....	.40
Brazing flux, per lb., net.....	.80

Machine Requirements and Industrial Construction

Equipment Wanted

Mass., Quincy (Boston P. O.—A. Griffin, 144 Rhoda St.—8 in. sheet metal brake and squaring shears.

Mich., Dearborn—City, B. P. Esper, Clk.—vertical screw power testing machine with accessories, 200,000 lb. capacity.

Mich., Detroit — Long Mfg. Co., 2768 East Grand Blvd.—machinery and equipment for the manufacture of automobile radiators for proposed 1 story, 105 x 120 ft. foundry on Dequindre St. Estimated cost $40,000.

Mich., Detroit — Stark Hickey, 8938 Grand River Ave.—machine equipment for proposed 2 story automobile sales and service building. Estimated cost $150,000.

Mich., Detroit—Moers Inc., 156 West Larned St. (metal stamping)—light power press and equipment.

Mich., Detroit—Newcombe Separator Co. of America, 1911 First St.—Universal milling machine, fully equipped.

N. Y., Astoria—Hurych Mfg. Co., 2431 Kindred (26th) St.—will receive bids until July 10 for gray iron castings, steel stampings, extruded aluminum shapes, aluminum die castings, commercial ball-bearings, precision ball-bearings, miscellaneius screws, Swedish iron cables, celluloid strips, paneled boxing material and corrugated paper.

Tex., Beaumont—J. W. Stuart, Gilbert Bldg.—filling station equipment, tire equipment, battery, vulcanizing, brake testing and storage departments for proposed 2 story, 120 x 120 ft. garage and repair shop. Estimated cost $75,000.

Tex., San Antonio — Yellow Cab Co., Inc., W. G. Duncan—complete machinery and equipment for proposed 1 and 2 story garage. Estimated cost $100,000 to $150,000.

Wis., Waukesha—Glancy Malleable Iron Corp.—two overhead traveling cranes, grinding machines, etc., for proposed addition to foundry at Wisconsin and Central Sts.

Ont., Hanover—Peppler Bros.—woodworking machinery and equipment for the manufacture of furniture, veneer, etc. on Main St. Estimated cost $60,000.

Ont., Merritton—Hayes Wheel & Forgings, W. Kisler, Mgr.—machinery and equipment for forging automobile wheels and parts for proposed 2 story, 85 x 100 ft. addition to factory. Estimated cost $100,000.

Que., Hull—Hull Iron & Steel Foundries Ltd., Montcalm St.—new heat-treating steel ovens to produce high grade alloy steel to be electrified which will mean the acquisition of an additional 3,000 hp. for proposed 4 story, 90 x 300 ft. foundry. Estimated cost $200,000.

Que., Hull — Hull Match Co., St. Redempteur St.—machinery and equipment for the manufacture of match making machinery for proposed factory. Estimated cost $125,000.

Opportunities for Future Business

Calif., Long Beach—Perfect Caster Co., awarded contract for a 1 story, 70 x 100 ft. factory.

Calif., Los Angeles—Standard Auto Body Works, 1501 South Central Ave., will build a 1 story, 100 x 140 ft. factory at 15th and Paloma Sts.

Conn., Bridgeport—Bridgeport Brass Co., C. E. Beardsley, Pres., East Main St., plans the construction of a brass rolling mill. Estimated cost $1,000,000.

Conn., Bridgeport—Model Tire Co., H. J. Platt, 322 Fairfield Ave., plans the construction of a service building at John Fairfield Ave. Estimated cost $100,000. Private plans.

Conn., East Hartford (Br. Hartford)—Pratt & Whitney Aircraft Co., 450 Capital Ave., Hartford, is having plans prepared for an airplane factory here. Estimated cost $500,000. A. Kahn Inc., 1004 Marquette Bldg., Detroit, Mich., Archt.

Conn., Hartford—R. P. Taber, 128 Allyn St., will soon award contract for a 1 story, 250 x 250 ft. garage and service station on Albany Ave. Estimated cost $175,000. A. Kahn, 1000 Marquette Bldg., Detroit, Mich., Archt. Noted June 20.

Conn., Stamford—Stamford Water Co., Summer St., awarded contract for a 2 story, 55 x 90 ft. shop. Estimated cost $40,000. Noted June 6.

Fla., Tampa—United States Phosphoric Products Co., J. E. McKee, Gen. Mgr., Ruskin Rd., East Tampa, will build a 1 story, 130 x 160 ft. galvanized iron treating plant. Estimated cost $300,000.

Ill., Chicago—C. H. Hanson Co., 178 North Clark St., awarded contract for addition to factory for the manufacture of brass baggage checks, plates, etc. Estimated cost $50,000.

Ill., Chicago—B. Mercil & Sons Plating Co., 1911 Fulton St., awarded contract for a 1 story addition to factory.

Ill., Chicago — Runzel Lenz Electric Mfg. Co., 1751 North Western Ave., plans to rebuild factory recently destroyed by fire. Estimated cost $150,000. Noted Mar. 14.

Ill., Cicero — Ostrander-Seymour Co., 1900 South 5th Ave., awarded contract for the construction of a 1 story addition to factory for the manufacture of machinery. Estimated cost $40,000.

Ind., Kokomo—F. D. Miller, 115½ North Buckeye St., is receiving bids for a 1 story, 100 x 204 ft. machine shop and service station at Buckeye and Superior Sts. Estimated cost $60,000. O. Cook, 622 Armstrong-Landon Bldg., Archt.

Ind., South Bend—D. C. Leer, 1222 Lincoln Way E., awarded contract for a 1 story, 66 x 100 ft. machine shop and garage at Michigan and South Sts. Estimated cost $42,000.

Mass., Cambridge (Boston P. O.)—J. B. Welch, 44 School St., Boston, awarded contract for a 1 story foundry on Lansdowne St.

Mass., Malden (Boston P. O.)—R. C. Clark, 73 Center St., is receiving bids for a 1 story, 60 x 190 ft. garage and repair shop at 105-107 Center St. Estimated cost $50,000. C. F. Springfield, 50 Park St., Archt. Noted June 27.

Mass., South Boston (Boston P. O.)—Old Colony Plating Co., 135 Old Colony Ave., plans additions and alterations to plant. Private plans.

Mass., Woburn—J. W. Finelli, 32 Adams St., Newton, will build a 1 story, 85 x 95 ft. repair and service garage at 32 Winn St. here. Estimated cost $40,000. M. Louis, 73 Cornhill, Boston, Archt.

Mich., Plymouth—Detroit House of Correction, 1441 Alfred St., Detroit, is having plans prepared for the construction of a group of buildings, including work shops, etc., at Prison Institution on Phoenix Rd. here. Estimated cost $1,250,000. A. Kahn, 1000 Marquette Bldg., Detroit, Archt.

Mo., North Kansas City—Mid-Continent Tank Car Co., 10th and Cherry Sts., plans addition to plant. Estimated cost $50,000. Private plans.

N. J., Lodi—Metkloth Co., Inc., Garibaldi Ave., is receiving bids for a 1 story addition to factory. Estimated cost $40,000. Liebau & Breiby, 238 Main St., Hackensack, Archts. Noted June 6.

N. J., Newark—E. C. Epple, 44 Commerce St., Assoc. Archt., will receive bids about July 15 for a 3 story, 20 x 206 ft. factory at Central Ave. from 16th to 17th Sts. here for Packard Motor Car Co., Broadway and 61st St., New York. Estimated cost $300,000. A. Kahn, 1000 Marquette Bldg., Detroit, Mich., Archt. Noted May 30.

N. J., Paterson—Watson Flagg Engineering Co., 214 Straight St., awarded contract for a 1 story, 75 x 125 ft. machine shop at 843 East 25th St. Estimated cost $40,000. Noted June 27.

N. J., Perth Amboy—Standard Underground Cable Co., 26 Washington St., awarded contract for a 3 story cable manufacturing plant. Estimated cost $200,000. Noted Feb. 28.

N. Y., Brooklyn—S. Esposito, and F. Buoniconto, 1067 67th St., will build a garage at 13th Ave. and 6th St. Estimated cost $40,000. Cassat, Muller & Ober, 44 Court St., Archts.

N. Y., Brooklyn—Lipe Realty Co., S. Pippoff, Pres., 843 Ocean Parkway, plans the construction of a 1 story garage and repair shop, etc. at 8th Ave. and 61st. Estimated cost $40,000. I. Kallish, 26 Court St., Archt.

N. Y., New York—Superior Fire Proof Door & Sash Co., D. Schaefer, Pres., 184 Carter Ave., plans a 2 story, 100 x 200 ft. factory at Bates, Poplar and Barbour Sts. Estimated cost $150,000. H. Ginsberg, 205 West 42nd St., Archt.

N. Y., Woodside—Realty Associates, 162 Remsen St., Brooklyn, plan the construction of three 100 x 200 ft. garage buildings at Maurice and 53rd Aves. here. Estimated total cost $150,000. B. Diesler Jr., 162 Remsen St., Brooklyn, Archt.

O., Akron—Firestone Tire & Rubber Co., South Main St., awarded contract for the construction of first unit of battery plant, 50 x 100 ft. Estimated cost $200,000.

O., Alliance — Alliance Steel Products Co., awarded contract for a 1 story, 50 x 60 ft. factory on Waverly Ave. Estimated cost $40,000. Guardian Safe Co., 2114 Superior Viaduct, Cleveland, lessee.

O., Canton — Timken Roller Bearing Co., awarded contract for a 1 story, 220 x 440 ft. tube mill on Gambrinus St. Estimated cost $200,000. Noted May 24.

O., Cleveland—F. Zimmerman Co., West 110th St. and Berea Rd., manufacturers of picture moulding, awarded contract for a 1 story, 30 x 120 ft. addition to factory at West 114th St. and Berea Rd. Estimated cost $40,000. Noted June 20.

O., East Liverpool — Patterson Foundry & Machine Co., awarded contract for addition to machine shop. Estimated cost $150,000.

O., Elyria—Elyria Belting & Machine Co., A. Altfeld, Pres. and Treas., awarded contract for a 1 story, 40 x 105 and 60 x 80 ft. factory. Estimated cost $40,000. Noted June 13.

O., Niles—Empire Steel Co., plans the construction of a plant to include a battery of fine continuous sheet steel furnaces, normalizing furnace and other equipment to increase cold roll production. Estimated cost $250,000.

Pa., Pittsburgh—Miller Printing Machinery Co., Reedsdale St. N. S., awarded contract for 1 and 2 story, 50 x 180 ft. addition to plant. Estimated cost $50,000.

R. I., Providence—Mason Box Co., A. A. Weller, 69 Sprague St., plans to rebuild factory destroyed by fire on Warren St. Estimated cost $40,000. Architect not selected.

Vt., White River Junction—Central Vermont R.R. Co., subsidiary of Canadian National Rys., Montreal, Que., P. D. Fitzpatrick, St. Albans, Ch. Engr., awarded contract for the construction of a round house here. Estimated cost $40,000.

Wis., Milwaukee—Chicago, Milwaukee, St. Paul & Pacific R.R. Co., Union Station, Chicago, awarded contract for a 1 story, 200 x 1,000 ft. shop. Estimated cost $950,000 to $1,000,000. C. F. Loweth, Ch. Engr.

Ont., Kitchener — I. M. Card Lumber Co., Brethruyith St., plans addition to plant. Estimated cost $95,000.

Ont., Newmarket—Office Specialty Mfg. Co., awarded contract for a 3 story, 55 x 200 ft. factory for the manufacture of office furniture and supplies. Estimated cost $150,000.

Ont., Toronto—Auto Strop Razor Co., 83 Duke St., awarded contract for addition to factory. Estimated cost $100,000.

Ont., Toronto—C. A. Dunham Co. Ltd., 229 College St., plans the construction of a 3 story, 40 x 50 ft. factory for the manufacture of heating specialties. Estimated cost $75,000. Private plans.

Ont., Toronto—F. J. Hartz Co. Ltd., 24 Hayter St., awarded contract for a 6 story factory for the manufacture of physicians supplies on Grenville St. Estimated cost $200,000.

Ont., Toronto—James Morrison Brass Mfg. Co., 93 Adelaide St. W., is having plans prepared for 4 story addition to factory for the manufacture of heating and plumbing supplies. Estimated cost $150,000. Noted June 6.

Ont., Walkerville—Chrysler Corp., J. D. Mansfield, Pres., plans a 5 story, 100 x 200 ft. addition to automobile factory. Estimated cost $500,000. Hutton & Sauter, Hamilton, Archts.